

POPULAR SCIENCE

MONTHLY



FROM "KITE" TO B-29. A fourteen-page picture history of the USAAF from 1907 to 1945. Page 84.



TOMORROW'S FIGHTER? Plans for a scale model of the Army's curious XP-55 Ascender. Page 154.



HOW PLANES FIGHT ICE. Mechanical devices save flyers from an unseen hazard of the air. Page 114.



YOUR POSTWAR AIR VACATION. What it's like to fly across-country in a lightplane. Page 54.

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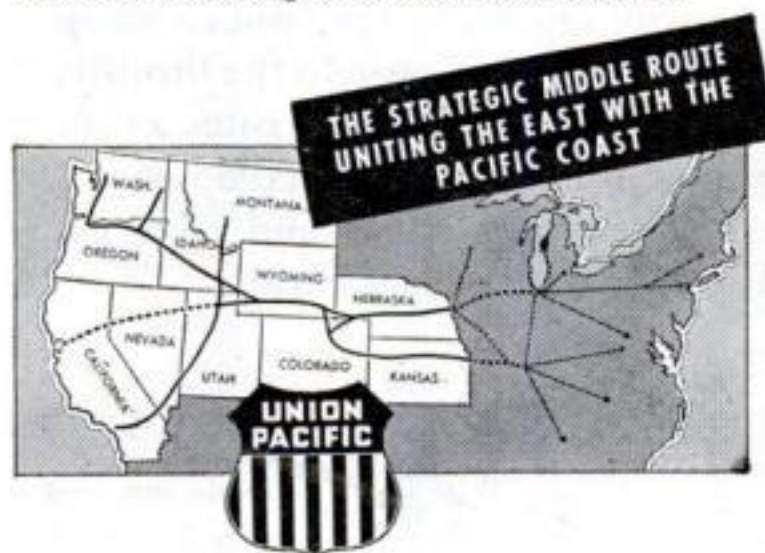
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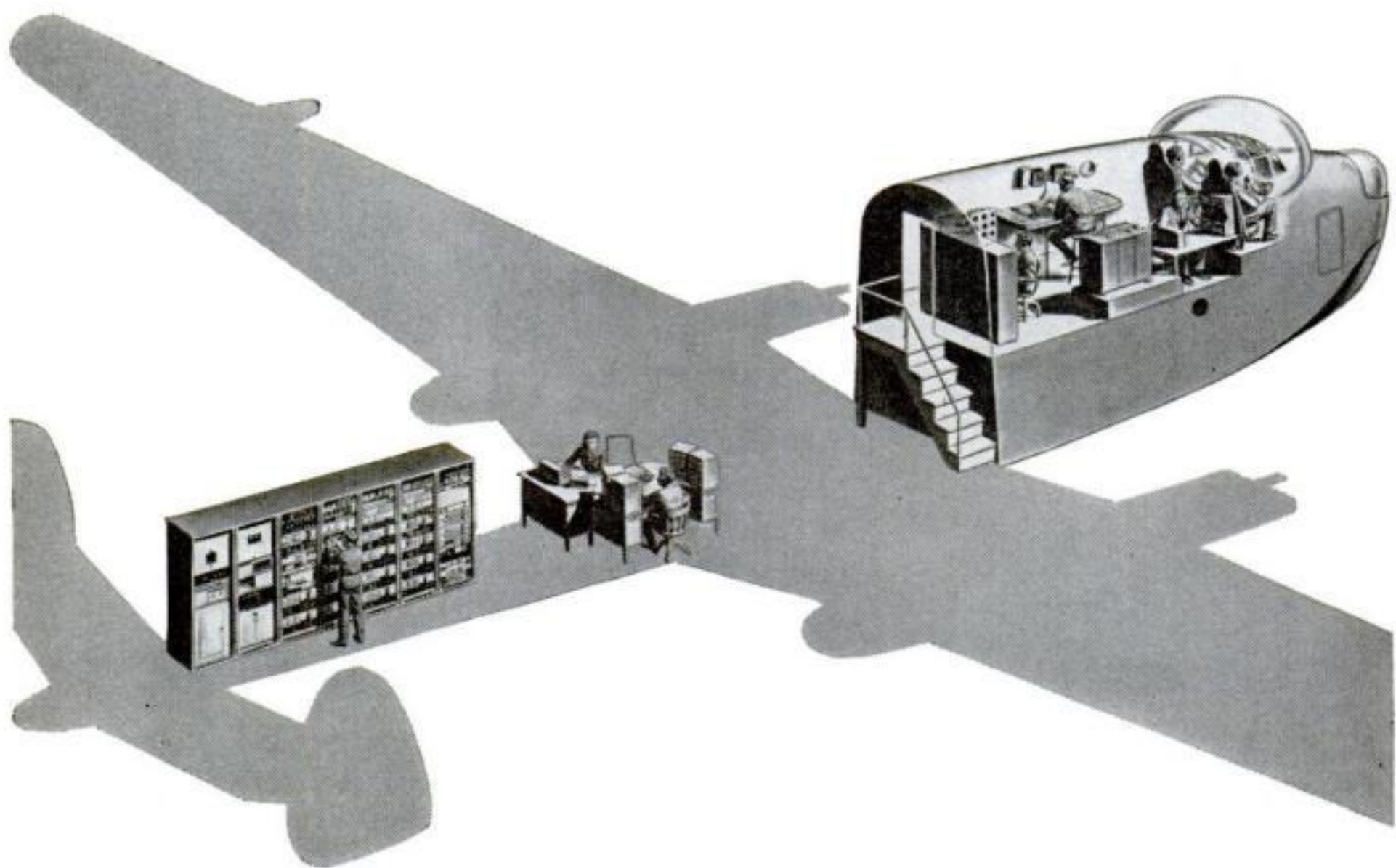


AUGUST, 1945

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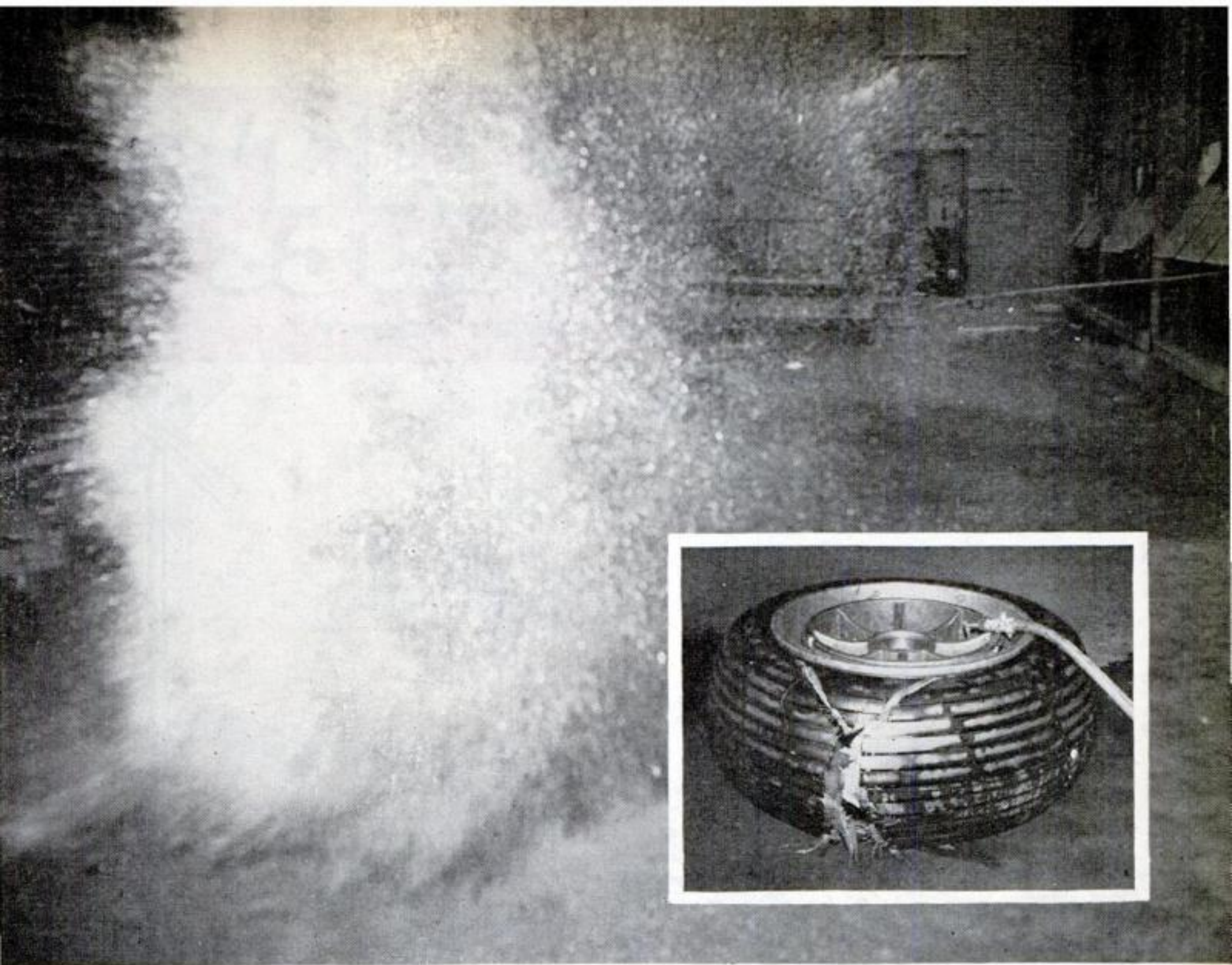
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VOL. 147 NO. 2

Mechanics & Handicraft

A TECHNICAL JOURNAL OF SCIENCE AND INDUSTRY

CONTENTS *for* AUGUST, 1945

Cover: Upper left, painting by Maj. John T. McCoy, Jr.; upper right and lower left, drawings by Eric Sloane; lower right, Kodachrome by William W. Morris.

News

Should We Gas the Japs?.....	49
Postwar Lightplane Vacation.....	54
Laying the Channel Pipe Lines.....	62
How "Fido" Licked Airfield Fog.....	64
Wall of Flame Guarded Britain.....	66
Portable Bridges for Tanks.....	67
Where Rockets Get Their Push.....	68
Pickaback Barges Aided Invasion.....	74
The AAF Moves Against Japan.....	78
Air War: the Story of the AAF.....	84
The Air's the Place to Fight.....	100
Doom for Deadly Shipwreck Rock....	102
Thermostats: Watchdogs of Heat.....	105
Odd Facts About Eyes.....	110
How Planes Fight the "White Devil"....	114

Automobiles

Meet the Postwar Jeep.....	122
Ford and Nash Show New Cars.....	125
Gus Gets the Low-Down.....	126

Home and Workshop

Clear Plastic as a Craft Material.....	130
Chip Carving Is Fun.....	142
Second Wind for Your Fan.....	148
Green Grows Your Lawn.....	152
Navy Models Enemy Planes.....	156
"King-Size" Micrometer Calipers.....	160
It's All in Your Point of View.....	166
Jobs for the Handie Talkie.....	172
Steamer Peels Wallpaper.....	179



"HAP" ARNOLD, Commanding General of the Army Air Forces, grew up with American airpower. As a lieutenant fresh from West Point, he flew the Army's first flimsy planes (page 87) and set early records for altitudes. This month Popular Science has the exclusive privilege of reviewing the glorious story of the AAF as told in the Official Pictorial History.

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PHOTOGRAPHY: W. W. Morris.

Published monthly at 353 Fourth Avenue, New York 10, N. Y., by Popular Science Publishing Co., Inc. Godfrey Hammond, President and Treasurer; R. C. Wilson, Raymond J. Brown, Stephen P. Glennon, Vice-Presidents; F. W. Briggs, Secretary. Entered as second-class matter Dec. 28, 1918, at the Post Office at New York under the act of March 3, 1879; additional entry as second-class matter at Dayton, Ohio. Entered as second-class matter at the Post Office Department, Canada. Printed in U.S.A. Copyright, 1945, by Popular Science Publishing Co., Inc. All rights reserved in the United States, Great Britain, and in all countries participating in the International Copyright Convention and the Pan-American Copyright Convention. Yearly subscriptions to United States and its possessions, \$2.50; Canada, \$3.00; foreign countries, excepting Canada, \$3.50. Subscribers must notify us of change of address four weeks in advance of the next publication date. Be sure to give both old and new address.

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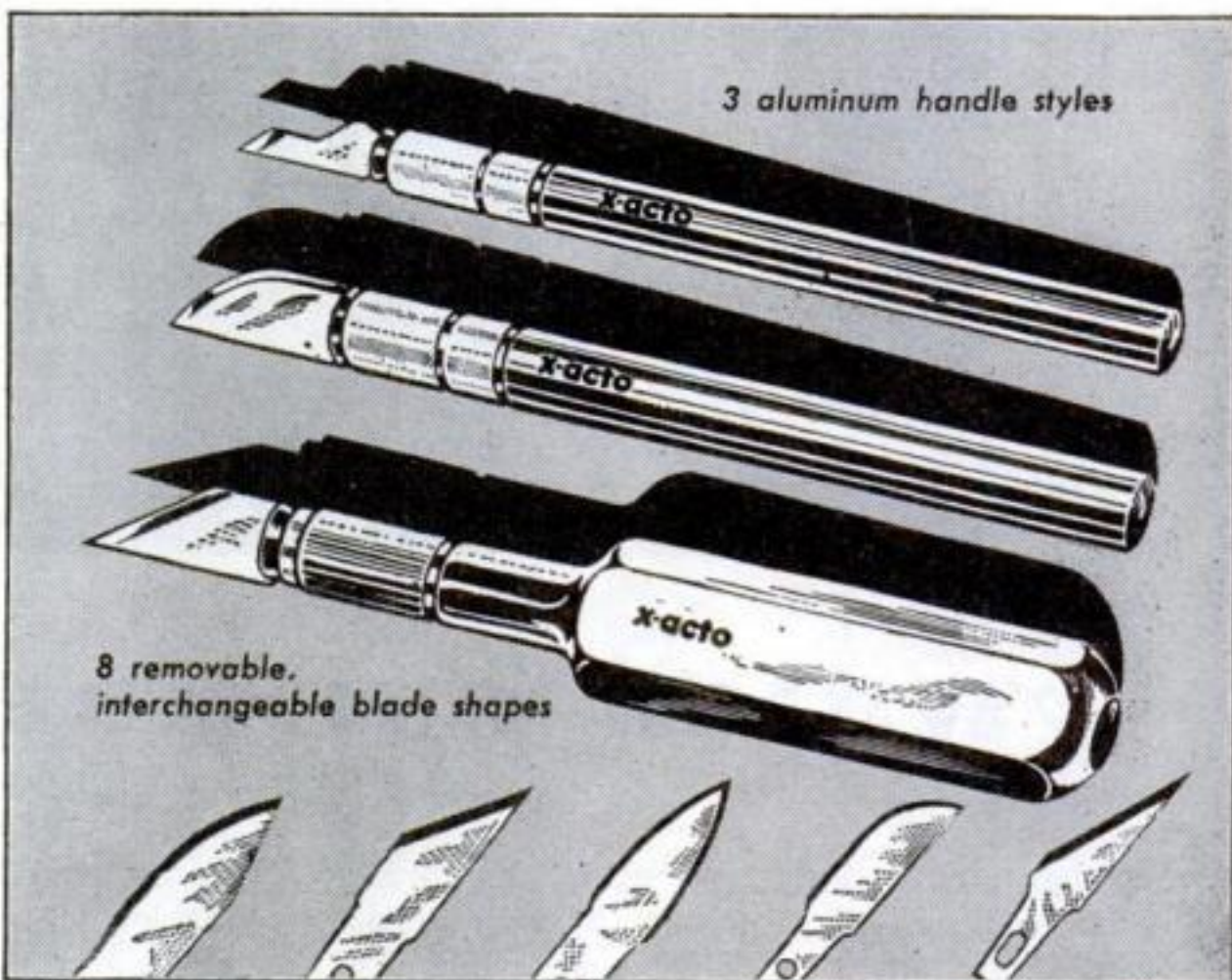
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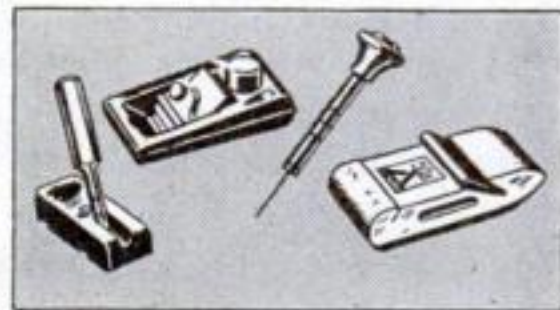


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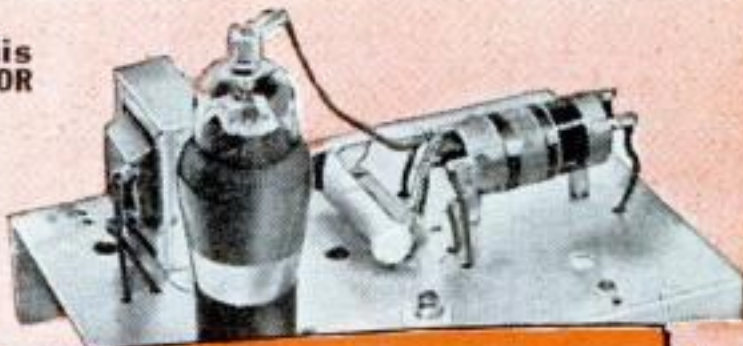
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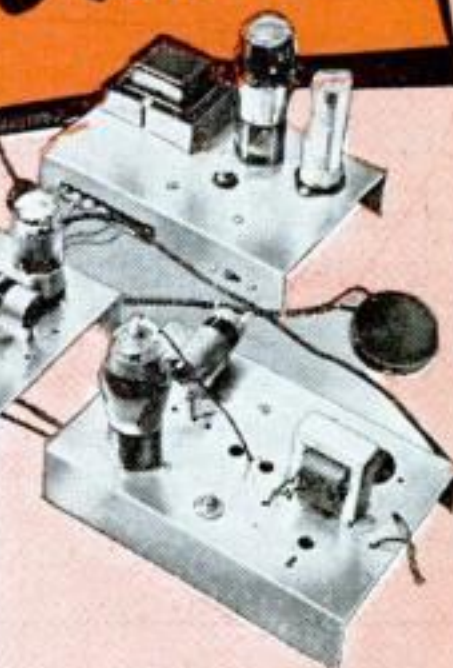
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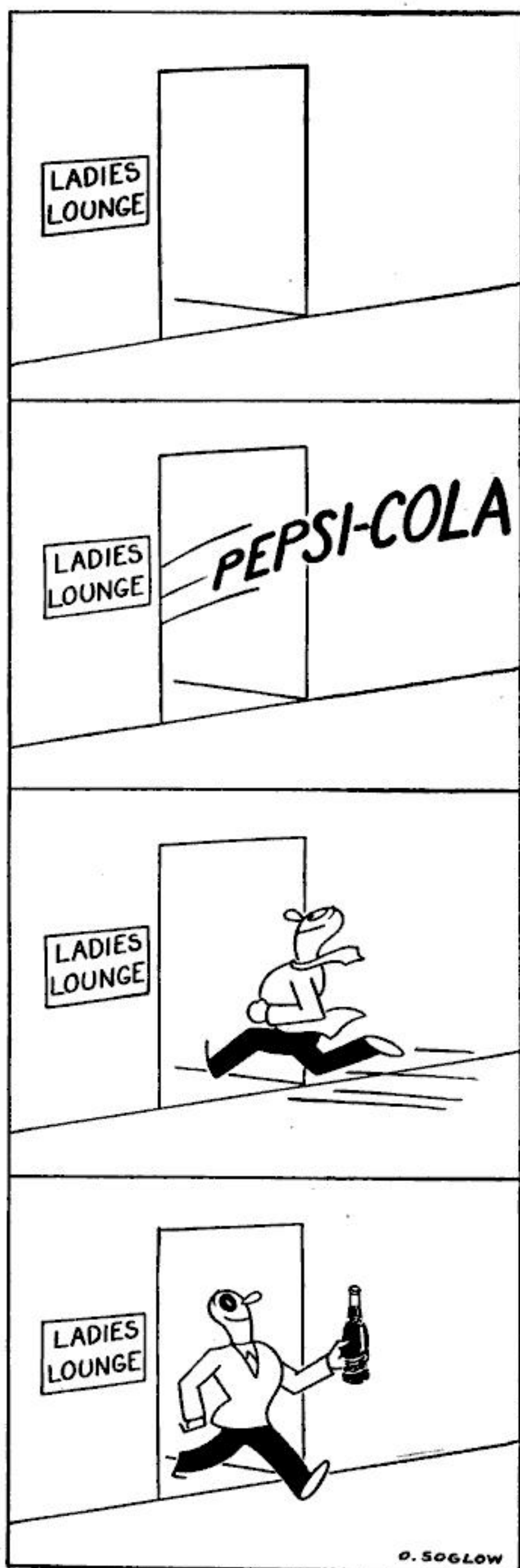
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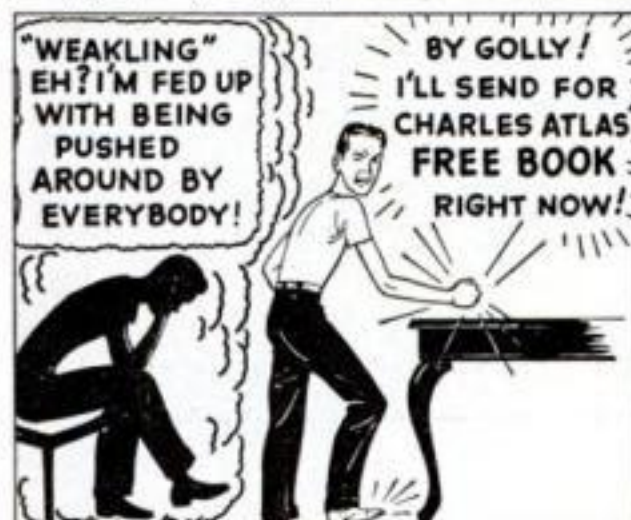
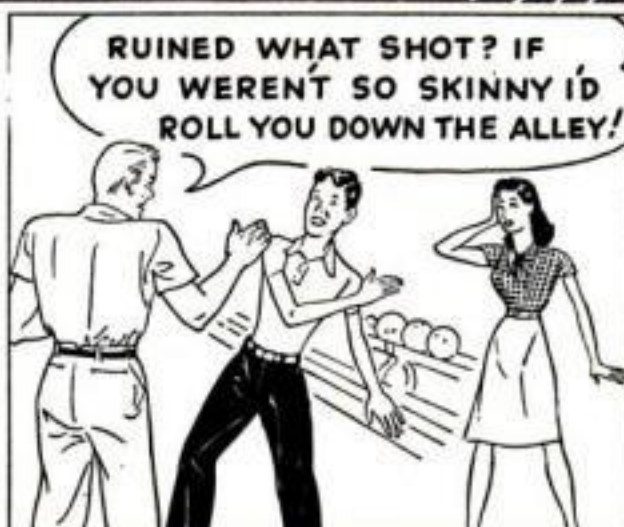
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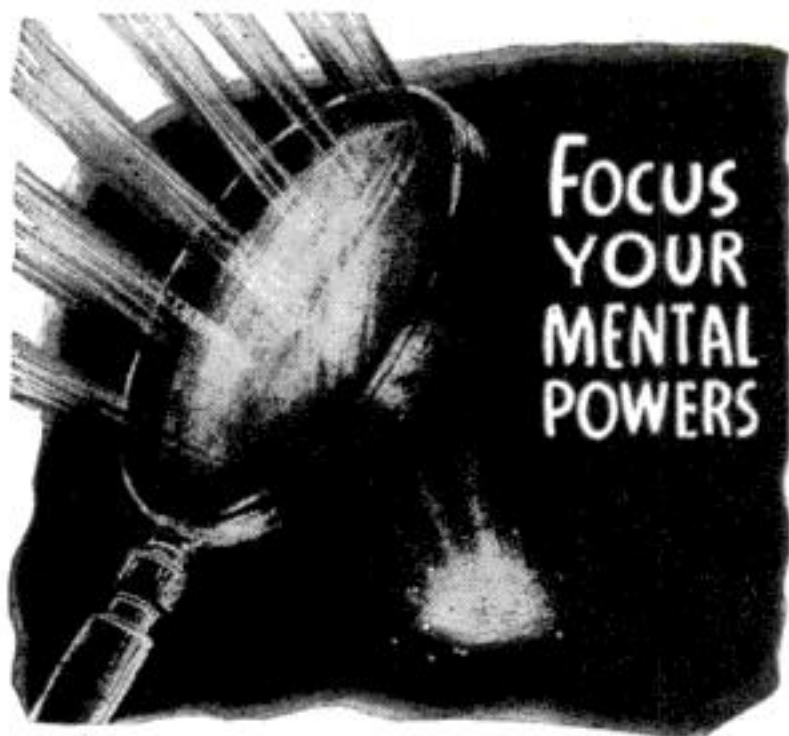
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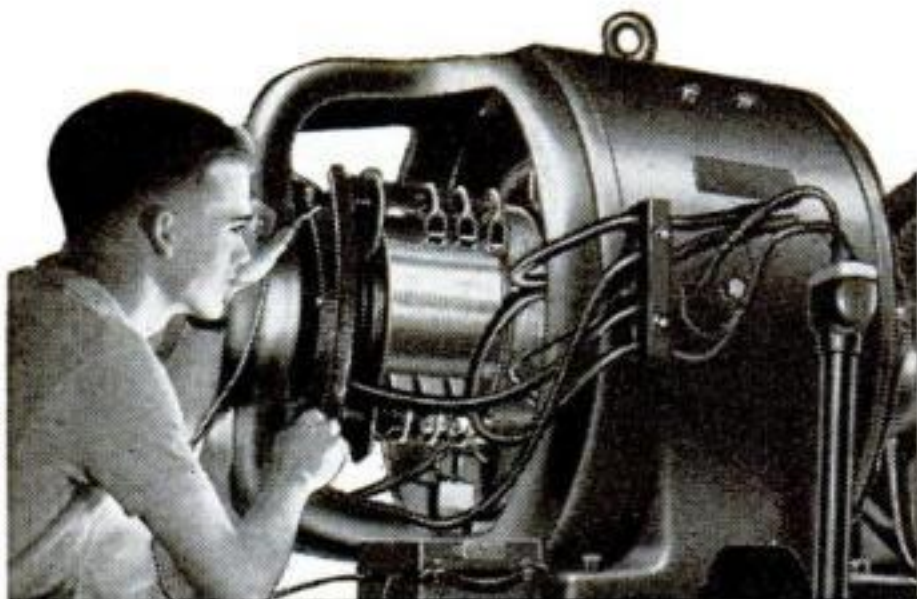
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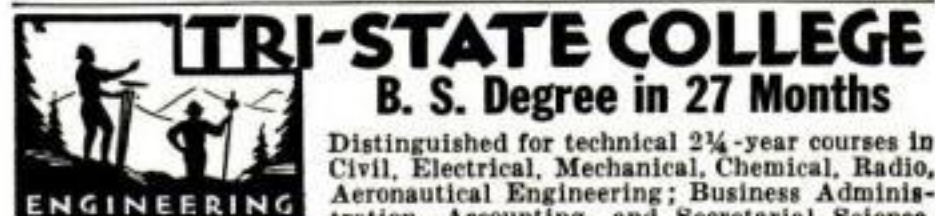
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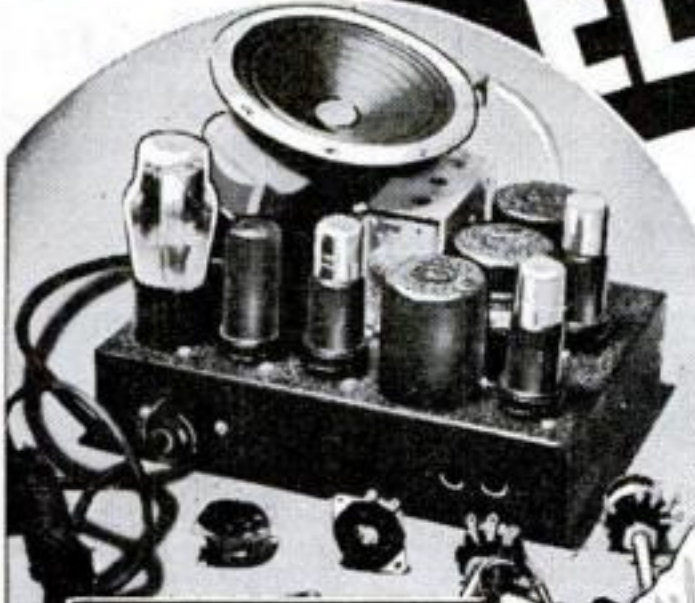
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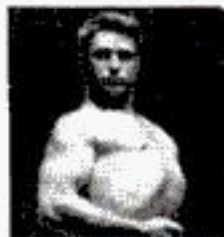
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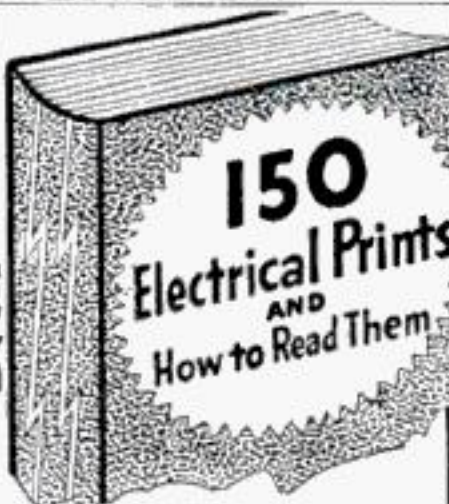
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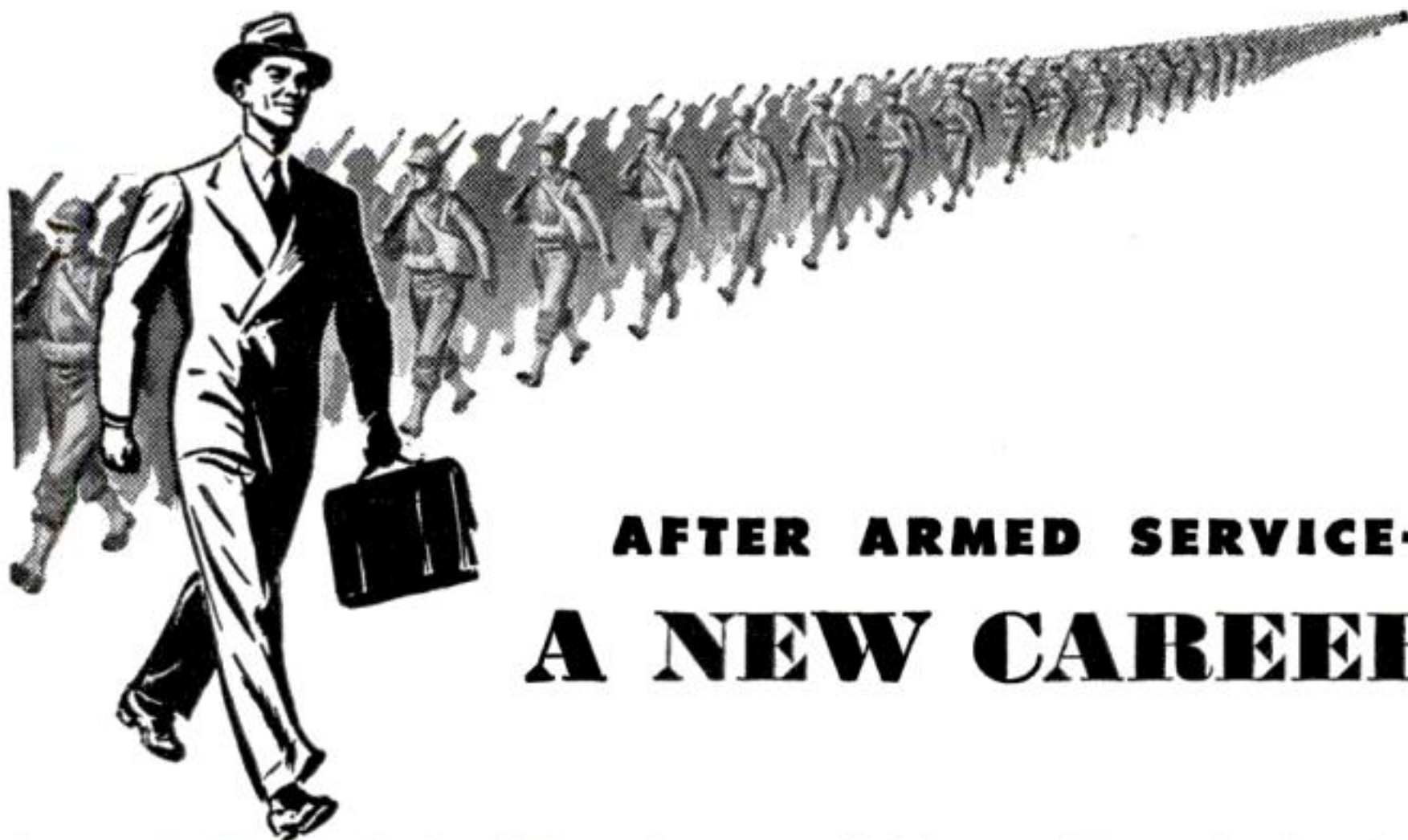
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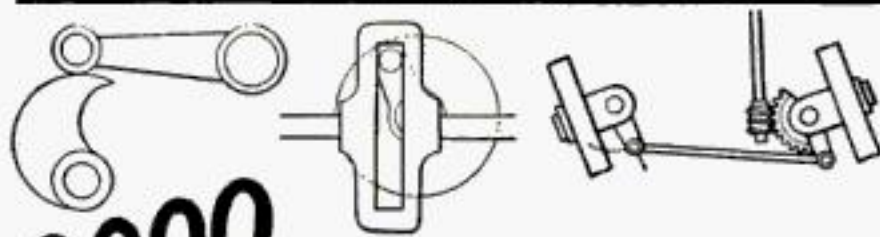
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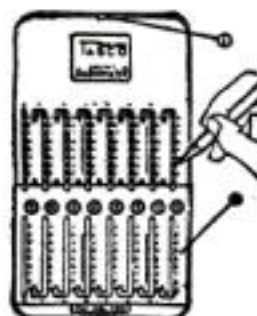


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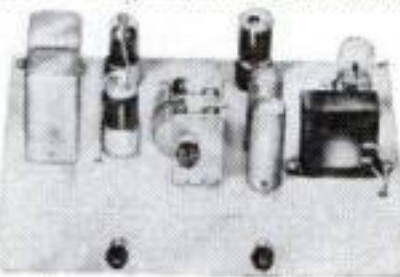
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AS ONE crackpot inventor to another, I should like to point out Mr. Smith's mistakes concerning the electron telescope in the June P.S.M. It appears quite obvious that he is not acquainted with the electron microscope, or he never would have brought up the idea. The electron microscope works on the following principle: the object to be magnified is mounted in a vacuum tube, where it is bombarded by a barrage of electrons. The image of the object is then projected onto a screen in the greatly magnified condition. Thus it would be impossible to apply Smitty's idea to a telescope. Friend Smith's notion is not nearly as bad as some of my own monstrosities, such as the radiographic stroboscope, hydraulic tire cooler, and my masterpiece, the hydromatic can opener with fluid

drive. Well, keep trying, Mr. Smith, and more power to you.—G. R. P., Jr., South Bend, Ind.

Sewer-Pipe-Joint Controversy Gets Into Its Stride

THE answer to Pfc. A. V. for a method of tinning cast-iron pipe can be found in the 1944 Transactions of the American Foundrymen's Association, page 768, in a report called "Wider Uses for Castings Through Surface Preparation," by J. H. Shoemaker and H. G. Webster. The authors describe a chemical method for this preparation of gray iron that can be followed by a "tinning" with a high-lead alloy and babbited to make bearings with a cast-iron backing.

The surface treatment is equally satisfactory for malleable iron, and, by means of the process, superior electrolytic coatings of all the standard types can be applied, and better soft-soldered, brazed, or silver-brazed joints can be obtained. The so-called tinning alloy must melt at a temperature lower than the melting point of lead, and so a bond between the prepared surface and lead poured in to make the joint ought to be formed readily. Lead has such a low yield point and high ductility that it ought not to fail in tension as suggested, even though the contraction is of the same order of magnitude as cadmium or magnesium.—H. F. S., Consulting Metallurgist, Minneapolis, Minn.

Here Is a New Name for Lazy Tongs

RESPONDING to a call in Readers Say for May, I suggest "rhombex" for the variable reach now called lazy tongs. It's derived from *rhombus* and the suffix *ex*.—R. R., Richmond, Va.

Bike Tires May Be Down but They're Never Out

ANSWERING the question as to what to do with worn-out bike tires asked in your May issue: In this part of the country, farmers use the discarded high-pressure tires to slip over the trace chains to keep the rough steel harness from rubbing the hair off the mules' or horses' sides. Besides, they say, it is easier to grab a covered chain than to handle it otherwise.—H. M. D., Commerce, Tex.

HERE'S a suggestion for the use of old bicycle tires. Remove the wire beading and put the tire over the cow's rump while milking. This will prevent her from swishing her tail in your face.—J. L., Vancouver, B. C.





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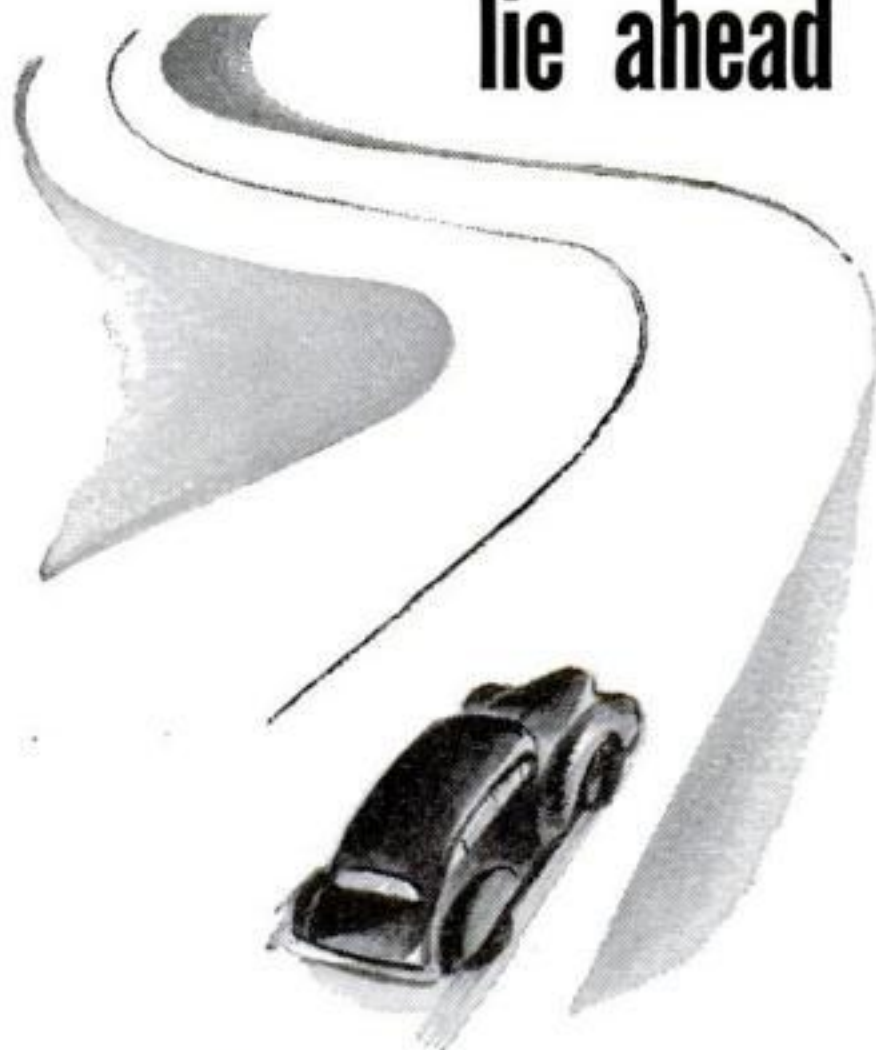
AUGUST, 1945

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31



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Readers Say:

Liners Have It— Why Not Trains?

I WAS glad to see the article on railroad signaling by radio in your April issue. Keep up the articles on communication. Can anyone tell me whether a radio-telephone service for passengers has been seriously considered.—W. H. E., Glendale, Ohio.



What Can This Man Do with a Lot of Sawdust?

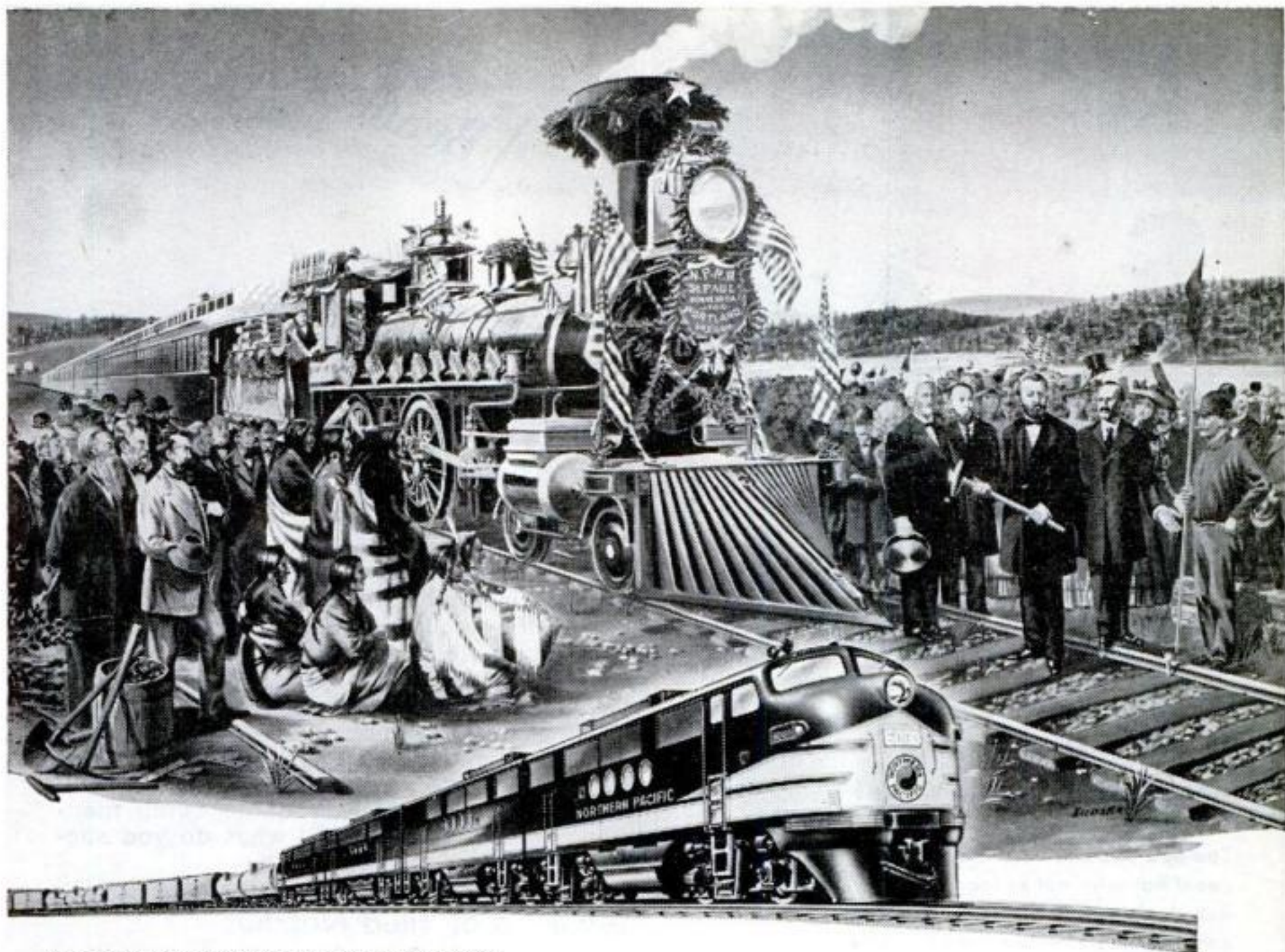
I HAVE at my disposal an almost unlimited supply of sawdust. It seems to me that this could be put to some practical use, and I can think of no better way to ask for suggestions than through POPULAR SCIENCE MONTHLY. Friends of mine have suggested that it can be converted into alcohol, wallboard, etc., but none of them seem to know the various processes. Any elaborate process would be impracticable.—H. B., Port Arthur, Ontario, Canada.

He Tells How You Can Blitz the Termites

You can assure J. H. T., Palo Alto, Calif., that it is possible to kill termites, or any other living organisms in wood, by subjecting them to high frequency on the order of 20 megacycles. This high frequency will heat the wood throughout to temperatures that will kill termites without injuring the material. The work can be done with a portable high-frequency machine brought to the premises. Radio Corporation of America, as well as others, manufacture such units.—I. C., Little Silver, N. J.

Experts on Chinning Should Answer This

IF A man can chin himself five times with one hand, how many times can he do it with both hands?—A. B. N., Syracuse, N. Y.



This painting of the driving of the Golden Spike on September 8, 1883, is a composite, in Currier & Ives style, of an actual photograph of the historic engine and a mural now decorating the Montana State Capitol in Helena.

WRITING NEW RAILROAD HISTORY

Sun glinting on yellow metal marked a great moment in railroad history that day in September, 1883. At Gold Creek, Montana, General U. S. Grant drove home a golden spike—and the Northern Pacific, first of the northern transcontinental railroads, was completed.

Shortly after, a special train puffed over the spot, carrying officials and distinguished guests from the East and Europe, on the first through train trip from St. Paul to Portland, Oregon.

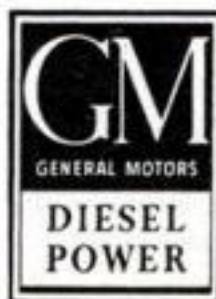
History is still being made on the Northern Pacific, as great trains of battle-bound

freight hurry westward in support of fighting forces.

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Readers Say:

Science Is Challenged to Include Idealism

THE public is constantly warned of the hazards of modern war, of the future scientific inventions designed to destroy whole armies and demolish huge cities in a matter of minutes. We all know that conferences have been held to prevent further aggression that may eventually terminate in the annihilation of world civilization. We P.S.M. readers are fully aware of the fact that a modern war cannot be successfully waged without scientists, inventors, and engineers to develop modern weapons. Man is creative, but sane scientists and inventors hate war. Their abomination of destruction is verified by their eagerness to create and build. Why, therefore, cannot the scientists of the world pool their thoughts and ideals and form an international organization dedicated to abolishing wars and serving mankind? Readers of P.S.M., what do you suggest?—L. S., New York City.

Speaking of Filed Notches on Thickness Gauges

THE idea of having filed notches on blades of thickness gauges, as presented on page 186 of the May P.S.M., is excellent. It is also true that these markings will stay on longer than the original stampings, but by the time the original stampings have worn off, the thickness-gauge blades will no longer be accurate. —(Miss) J. E. A., Salisbury, Md.

Better Leave the Wife's Sewing Machine Alone

ON PAGE 111 of P.S.M. for May, I noticed the new easy-opening envelope idea. So I made off for the nearest sewing machine, removed the thread, and ran a few envelopes through. After I had about a dozen, I went to my typewriter and printed the words, "Tear open along perforations." It's very easy.—N. H. K., Brooklyn, N. Y.

NEW DESK EQUIP-
MENT FOR
SECRETARIES

Easy enough, as N. H. K. says, but hardly adapted to quantity production. How to turn out millions is perhaps the most important part of the inventor's idea. Tooling up for the job offers a bit of a problem.—Ed.



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SO IT NEEDS FIXING

By S. T. CHRISTENSEN
the "Fix-it Man"

"**W**ELL, I guess I'm the fellow to see, for I've repaired thousands of refrigerators (home and commercial both), vacuum cleaners, radios, washing machines, irons, fans, lamps, mangles, motors, etc. In fact, many of my customers call me their "electrical appliance doctor." And, "doctoring," I might add has paid me a good substantial income for quite a few years. Funny, in a way, how I got started. Always liked to tinker and by experimenting around I found that most electrical appliances had many things in common. That, regardless of what the appliance was used for, or who the manufacturer was, the basic principles were much the same. From fixing my own appliances to fixing friends' and then for strangers at a fee, seems now to have been but a small step.

What to Charge?

At first, I let the owner decide the charge and, frankly, I was amazed at what I earned per hour. But then, when one figures what initial costs are involved in buying most electrical appliances, one can readily see that spending extra dollars for repairs is well worth while. Before long I was making more in my spare time repairing than from my regular job. The result . . . I went into business for myself. When war came, business boomed, for new appliances were not available.

For a while, repair parts (needed on some jobs) were a little difficult to get. But that

situation seems to have adjusted itself for many repair parts have today the high priority rating of AA2. After all, we must provide for the health and well-being of our civilian population.

The Future Offers

Friends ask me about my future. And, I think I've got a grand one. Age is no handicap in repairing. I have in my files enthusiastic letters from repairmen ranging in age from 18 to 79 years. After the war, we're bound to see hundreds of new products on the market . . . products that the average person never dreamt of. These new products and our old appliances are all going to need at some time or other "fixing." Well, I'll still be the fellow to do it. The field open for appliance repairmen is unlimited. I don't worry at all about too much competition.

If You Are Ambitious

To the contrary, I've prepared a complete course, chuck full of simple, easy to understand photos and drawings and written in the same non-technical language as this article. I know the course is good, because I have hundreds of men all over the country writing to me telling me how the course has helped swell their pockets with cash. If you too want to prepare now for your future, I suggest you read the next page and send me the handy coupon."

Adv.



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If now in war work, start your home appliance repair business NOW in your spare time and be set with a business of your own when the war is over. You don't need elaborate fixtures or expensive equipment to be a successful repairman. Operate from your garage, basement, vacant store, etc. Work as many hours as you wish—the home appliance repairman is his own boss. It is a profitable occupation for on many types of repairs it is not unusual for a repairman to charge on the basis of \$5.00 to \$6.00 per hour. Don't gamble with your future—learn a trade that will always support you. Remember, as long as electrical appliances are used, there will be a need for electrical appliance repairmen.

If you are at all mechanically inclined—can hold and use tools—then you have all of the qualifications required for becoming a big money earning home appliance repairman. It does not matter if you have not had a great deal of schooling or had previous experience along these lines—WE WILL TEACH YOU. Age should be no barrier—nor should any minor physical handicap.

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I am a mechanic for the Western Union Telegraph Co. Three days after receiving the lessons in refrigeration I earned the exact cost of the course.—Henry S. Lee, Washington, D. C.

I work day times at the shipyard and after 4:00 P.M. I operate from my cellar and garage. I average \$10.00 to \$15.00 clear every day.—Walter Hanhy, Brockton, Mass.

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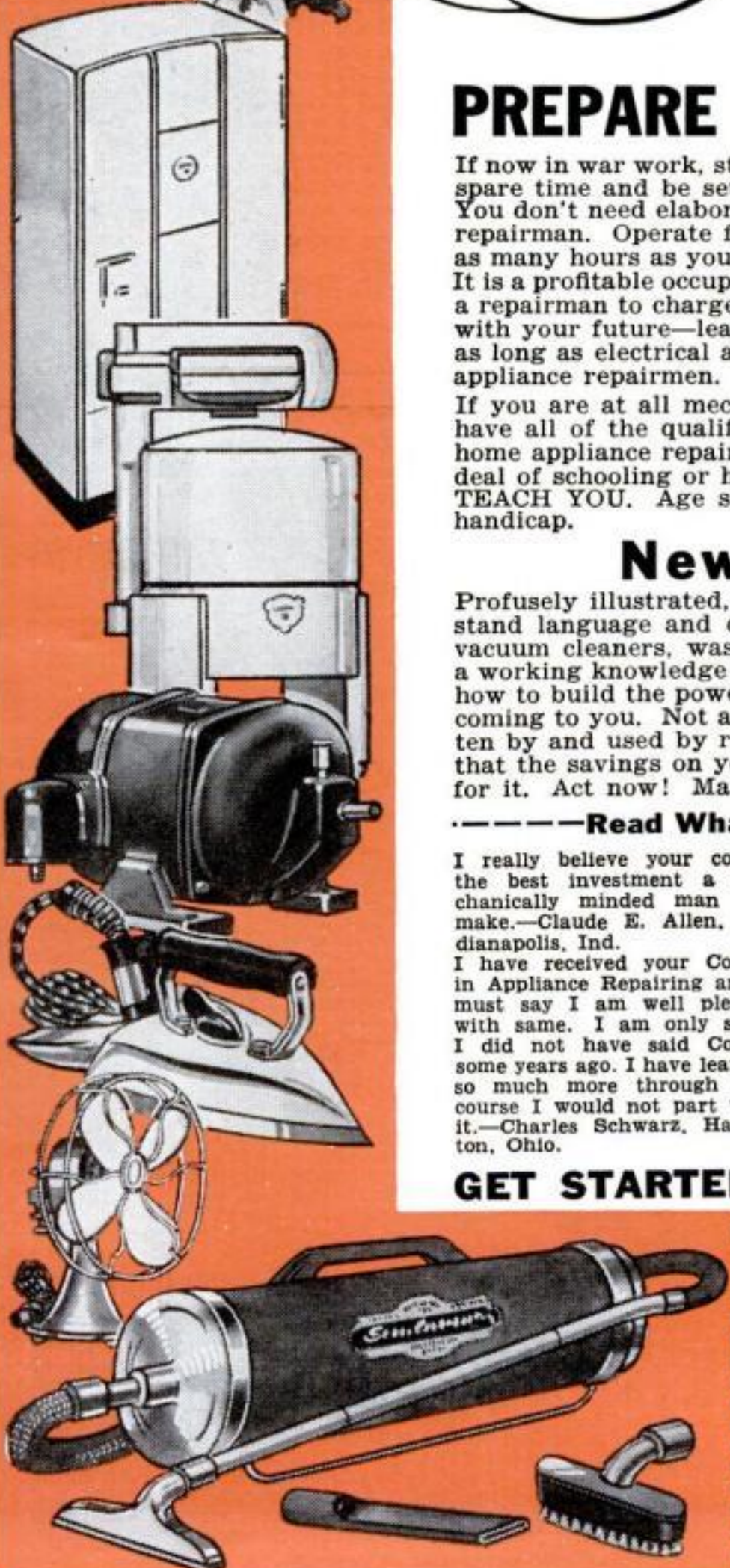
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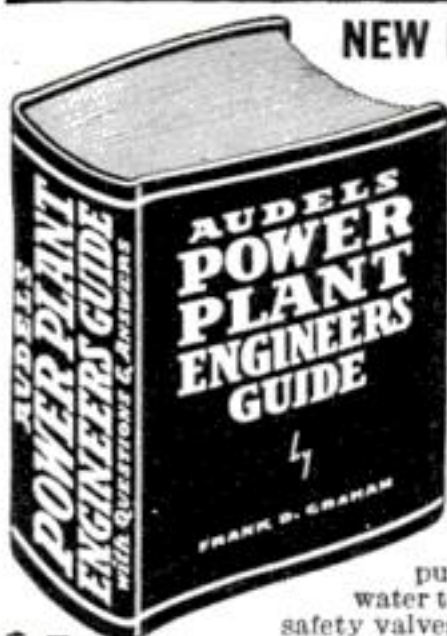
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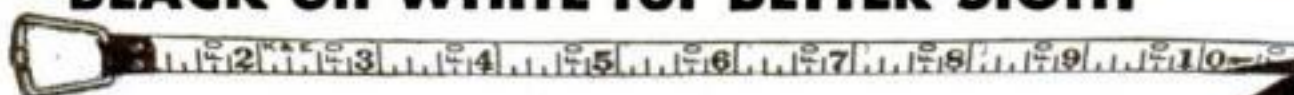
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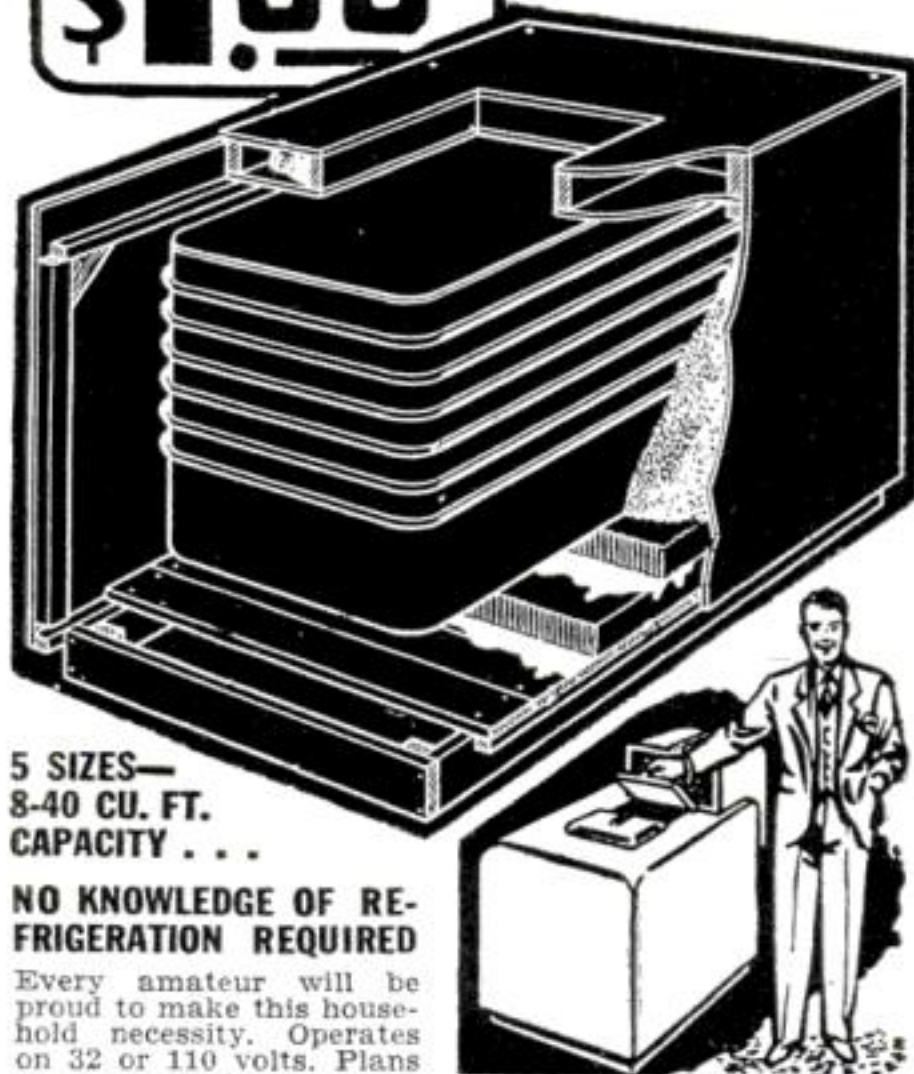
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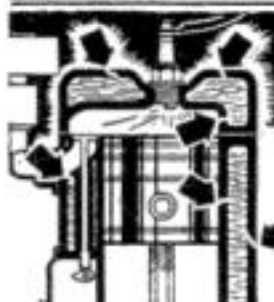
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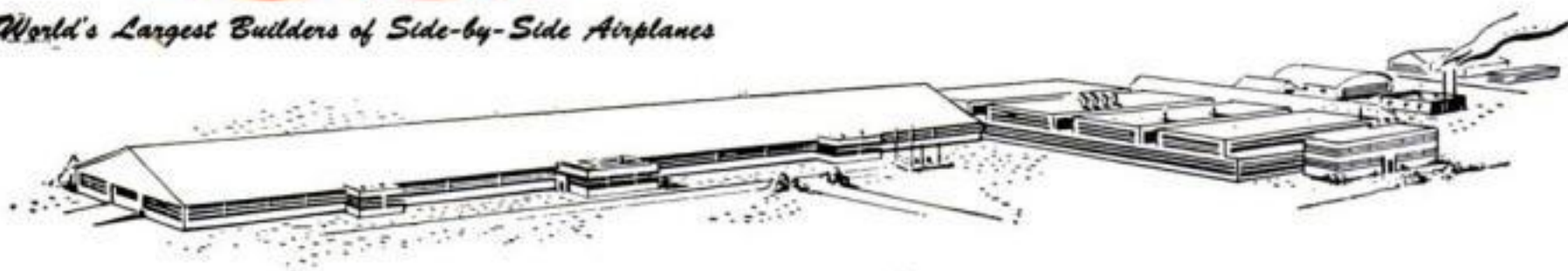
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This article discusses a controversial question. The editors will welcome expressions of opinion from readers, whether in agreement or disagreement with the views expressed by Major Eliot.



Should We **GAS THE JAPS?**

MAJOR GEORGE FIELDING ELIOT,
NOTED MILITARY COMMENTATOR,
ASKS AMERICANS TO FACE FACTS

If the Japs retaliate, we are better prepared to use gas than they. We can bomb their gas-producing plants and communications. We are ahead of them technically.

THIS writer is convinced that the time has come to use poison gas as a weapon against Japanese troops in the field.

The consensus among military thinkers is that gas would save American lives. It has not been used because of world-wide public revulsion against this form of invisible death ever since it was introduced in World War I.

I'm not recommending that gas be used against Japanese civilians. The deliberate killing of civilians, by whatever means, would be shocking to our consciences. In the course of destruction of military targets by air attacks, a good many civilians do get killed or wounded, but the purpose of the attack is to destroy the military target, and not to kill civilians.

Is gas worse than flame throwers?



Searing tongues of flame left this heap of smoldering Japanese bodies around a pillbox in a Manila street.

There isn't any international agreement to which we are a party which bars us from using poison gas. The last attempt at such an agreement was made at Geneva in 1926, as a part of the disarmament discussions. It was called the Geneva Gas Protocol. But the U. S. Senate refused to ratify it. Nor did Japan ratify it. So we're clear on that point.

All Japanese hopes now are centered on the price they can make us pay for victory. They have no hope of regaining the offensive. Their sea and airpower have been so reduced as to be of little more than nuisance value. But they have a strong army, composed of tough, hard-bitten soldiers who know how to die; and they have a defensible terrain which gives every opportunity for stubborn yard-by-yard defense. Few parts of Japan are far from mountains or really distant from the sea. Their foot soldiers and their terrain are the two main factors in their defensive armory. So their strategy is simple: Come and get us, and see what it will

cost you! It is the only strategy that is possible under the circumstances.

The Japanese, in other words, have lost the war but must yet be made to admit it. Doing this may cost tens or hundreds of thousands of American lives, and infinite suffering from wounds and permanent disablements, if we have to take Japan yard by yard as we have taken Iwo and Okinawa. Iwo consists of only about eight square miles, but it took us 26 days to conquer that tiny island, and 4,189 Americans gave their lives and 15,308 were wounded in the process.

Under these conditions, we must certainly ask ourselves whether it is not time to consider once more, and very carefully, the use of chemical agents to end this war.

For some reason that I cannot comprehend, the use of gas in warfare seems to shock the average mind. We accept the use of incendiary agents against Japanese cities, though we must be perfectly aware of the extent and nature of

Less humane than heavy explosives?



Shattering shell bursts ended the resistance of these enemy soldiers who held up advancing Marines on Guam.

the casualties thus caused. We accept the use of high explosives in all forms. We accept the motion pictures that show us flame-throwing tanks going into the attack on Japanese positions. But we shudder if anybody says "gas."

Apparently, it is more humane to kill people with third-degree burns, or by smashing their bodies by shellfire, than it is to asphyxiate them; apparently it is morally all right to burn them up with flame, but wrong to sear their hides with mustard gas. I don't know why, but that's the way many people feel about it.

Let's translate this, however, into terms of American lives and see how it looks. Let's take a test case: Okinawa. This island is only 67 miles long and has a maximum width of only 10 miles. But conquering it took nearly three months and 45,029 casualties, because we had to root out the Japanese from a terrain deeply indented by valleys and gullies, pock-marked with caves, and further protected by all sorts of artificial defenses, including deep shelters,

trenches, and covered lines of communication.

We brought to bear against these Japanese defenses the heaviest sort of concentrated fire — by aerial bombardment, naval gunfire, artillery, machine guns, and mortars. We proved once more what every soldier knows: you can't shoot well-dug-in infantry out of positions. You have to go in and drive them out with bayonet, rifle, and grenade. You get a lot of your own infantry killed doing this.

This sort of terrain prevails over most of the Japanese islands. Japan proper has an area of 147,889 square miles, and is traversed by lofty ranges, with summits separated by low passes and valleys. The Japanese, in defending Okinawa to the last, were in effect saying to the American people: Look at what one little island is costing you! Are you going to pay a proportionate price for the whole of Japan, piece by piece?

The problem will be much the same. We can isolate one piece of Japan after another. We can knock out the Japanese guns and tanks.

We can shoot their planes out of the air. But we still will have to go in and dig out their infantry — and pay the price.

Would gas help us do this job? Would it reduce American casualties appreciably? There can be very little doubt that it would do so. Persistent gases are heavier than air. They sink into valleys, caves, and deep shelters. They reach men in positions that are perfectly protected from the blast of high-explosive shells. They are especially adapted for just the type of warfare with which the Japanese are now confronting us.

Gas is no more the perfect weapon than high explosives or fire. It has limitations, just as all weapons have. It will not win the war by itself.

But it will enable us to win it at far less cost in time and casualties.

If we use gas, of course, the Japanese will use it, too. But the Japanese are far less technically and industrially prepared to use gas than we are; and their means of producing and transporting it are subject to direct attack, to which the Japanese cannot reply in kind. We can bomb their gas-producing plants, the railways by which they transport gas to the front, and the depots behind the front in which they assemble gas and the appliances for using it. The Japanese are too weak in the air to do the same to us.

Would the Japanese use gas against Chinese civilians if we used it against Japanese soldiers? Very likely they would if they could. But the

FACTS ABOUT GAS...

Every division of the U. S. Army includes a chemical section. Its weapons now are smoke and flame, but its personnel is also trained to spread poison gas. Japanese battle orders have revealed the enemy's fear of toxic gas. Chemical Warfare Service troops are high-priority targets for enemy guns. Only the cavalry, infantry and Air Forces have reported a higher ratio of men killed in action than the CWS.

War gases are divided into two groups: the blister gases and other gases. The blister gases are (a) mustard, (b) lewisite, and (c) the nitrogen mustards. Mustard and lewisite are heavy, dark, oily liquids; nitrogen mustards are colorless or pale-yellow solids or liquids. All three vaporize slowly. They cause itching, redness and blisters on the skin, and injure the eyes, lungs, nasal passages, and throat.



The other gases include (a) the choking gases such as phosgene, diphosgene, and

chlorpicrin; (b) the blood and nerve poison gas, vaporized hydrocyanic acid; (c) the tear gases, chloracetophenone solution and brombenzylcyanide; and (d) adamsite, which causes headaches, vomiting, sneezing, and coughing.

Great quantities of a new type of quick-acting gas called Green Ring III were found after Germany was conquered. Experts reported that tests on animals show it went beyond anything that the Allies had, but the Nazis had not dared to use it. Barge loads of decontaminating trucks were sent to Europe before the invasion of Normandy. To casual observers, they seemed merely to be machines to keep our soldiers free from lice and vermin. But they had additional significance to enemy agents and informers: These trucks were ready to clear the beaches of gas, if the Nazis used it. One type of 400-gallon decontaminating truck has been nicknamed the Do-It, because enterprising American chemists have found that they can go almost anywhere and do almost anything with it.

Gas can be hurled into the enemy's hide-outs in as many ways as high explosives. A 155-mm. artillery shell, for example, will carry 11.4 pounds of mustard gas. For short-range work, the U. S. has a 4.2-inch rifled mortar (P.S.M., July '44, p. 60) that was developed especially for chemical warfare.

effective use of gas is a weight-carrying proposition, and the Japanese do not have a weight-carrying air force. They have, in fact, almost no heavy bombers. The use of their medium bombers to attack Chinese cities with gas would be about as uneconomical a waste of effort as could be imagined.

As for Japanese defensive measures, of course they would do what they could. There is good reason to believe that long immunity has caused them to neglect their gas defense. Gas masks captured in Burma and the Pacific in recent months have been found useless because the chemical "filters" had not been renewed. The "gasproofing" of caves and underground defenses is not easy, especially for a country whose whole

industrial plant is under heavy attack. It would be very difficult for the Japanese to produce something new in great quantities.

I can think of no good reason, on strictly military grounds, why gas should not be used. It is hard to say whether there is a psychological or moral reason. Would our people and our allies react unfavorably? It is hard to believe that they would if the saving of lives was made clear to them.

The Japanese have lost the war. The thing to do is to get the fighting over with, to convince the military fanatics that they must give in, and to do this without losing any more of our young men than is necessary. I believe the case for the use of gas now is a strong one.

It is easily transported and can be used to fire 20 shells a minute, each weighing 25 pounds and containing 6½ pounds of mustard gas. This "goon gun" is being used extensively now to hurl high explosives, smoke, and white phosphorus.



Chemical land mines, irritant candles, and hand grenades are additional means of cleaning out pockets of the enemy's stubborn troops. The mines, containing 10½ pounds of mustard gas, are burst by a primacord charge. The candles, consisting of two pounds of adamsite, are ignited by a match-head stroker and burn for two minutes. The hand grenades weigh about a pound and burn for 40 seconds. Explosives and shells cease to be effective as soon as they come to rest, but chemical agents, such as mustard gas, remain effective for hours or days.

Chemical bombs, ranging in size from 100 to 1,000 pounds, are known to have been developed for use by the American air



forces. Poison gas also can be sprayed from airplanes (P.S.M., June '42, p. 102). A single light bomber with zeppelin-shaped tanks of gas liquid under its wings can contaminate an area a mile long and 300 yards wide in winds of from five to 10 miles an hour. Spraying is considered one of the most effective ways of attacking with gas.



Yet gas is a comparatively humane weapon. World War I casualty figures show that only one out of 14 victims of gas died, whereas one out of every four victims of other weapons died.



Here's a sample of the pleasures that await the air tourist of tomorrow. Devon Francis and Hans Groenhoff drop their lines into a Colorado lake more than a mile above sea level. Their plane is a two-place, 65-horsepower Aeronca Chief, selected from others of its type by the system of eeny, meeny, miney, mo.

POPULAR SCIENCE Takes You on *A Flying Vacation*

WHAT IT'S LIKE TO GO TOURING IN A SMALL PLANE



WRITER AND PHOTOGRAPHER took turns at the controls during their trip from New York to Colorado and back. Here Devon Francis, at far side of cockpit, pilots the plane and talks to an airport control tower by radiotelephone as Hans Groenhoff watches the map. By having one man study the course while the other flew the plane, they solved the navigation problem—which could prove to be a handful for a man flying the plane alone.

A FEW clouds sat starkly in the sky against a backdrop of light blue. The wind sock atop the south hangar at New York's Flushing Airport hung limp.

This was our day. We had been held up 24 hours by weather on the start of a combination vacation and fact-finding trip in a light airplane that was to carry us to the Rocky Mountains and back. Now the weather man was making up for his miserable performance of yesterday. He gave us CAVU (ceiling and visibility unlimited) conditions across the Alleghenies, birthplace of many Eastern Seaboard storms.

My companion and copilot was Hans Groenhoff, who for years has specialized in aviation photography.

A vacation in a light airplane is considerably different from one in an automobile. The weight problem must always be considered in a plane. You can't take so much. But, of course, you can go farther in less time. More important, our plane imposed on us three considerations foreign to the automobile vacationist: navigation, weather, and routes that would permit emergency landings.

To take this trip we had to be equipped with Federal private-airplane pilot licenses



SMALL TOWNS look pretty much alike from the air, unless there are outstanding topographical features to identify them. This fact makes plenty of trouble for the private flyer who navigates by "contact." This is Bristol, in eastern Colorado . . .

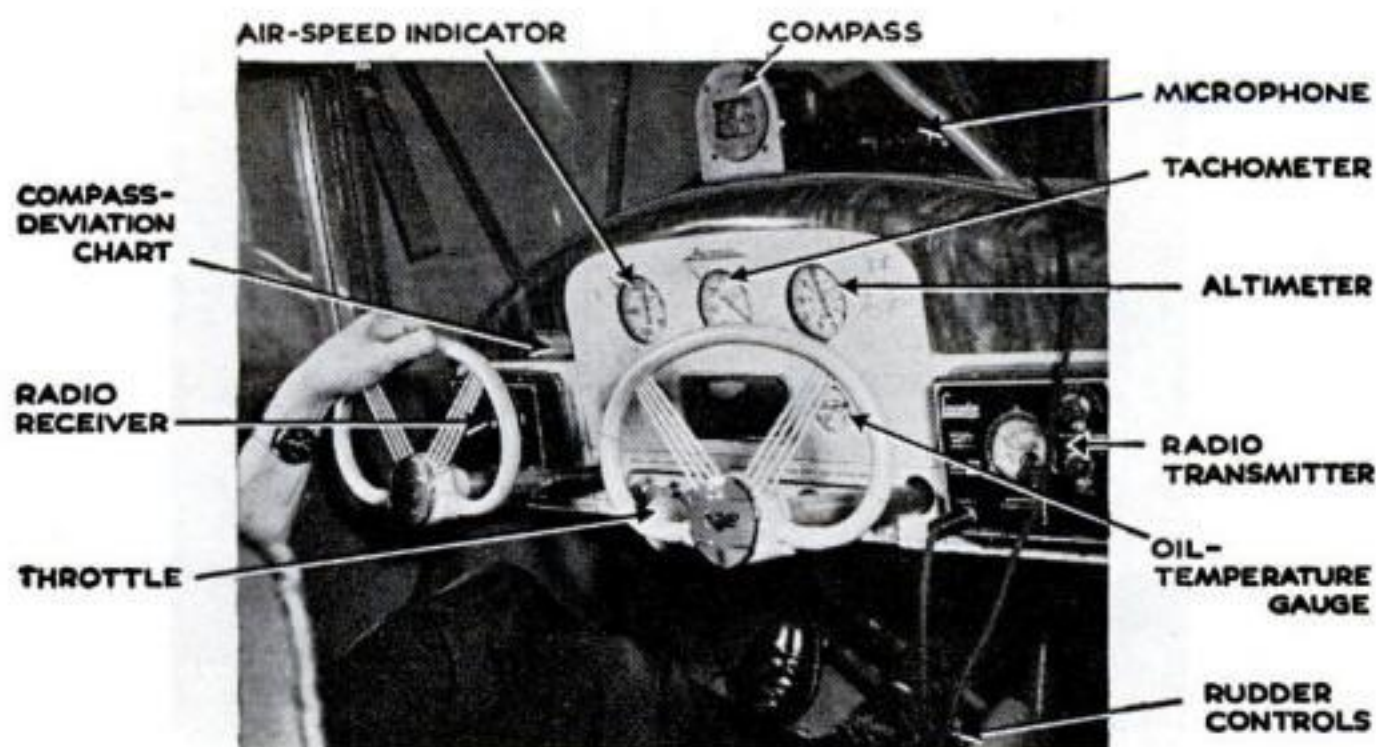


. . . and this is Brownstown, Ill. One of the greatest handicaps for lightplane travel, our flyers report, is the lack of identifying markings around towns and landing fields. It actually seemed as though private airport owners had tried to camouflage their fields.

or "airmen certificates." But either of us could have taken the other along as a non-license-holding passenger. Each of us also held a restricted radiotelephone license from the Federal Communications Commission.

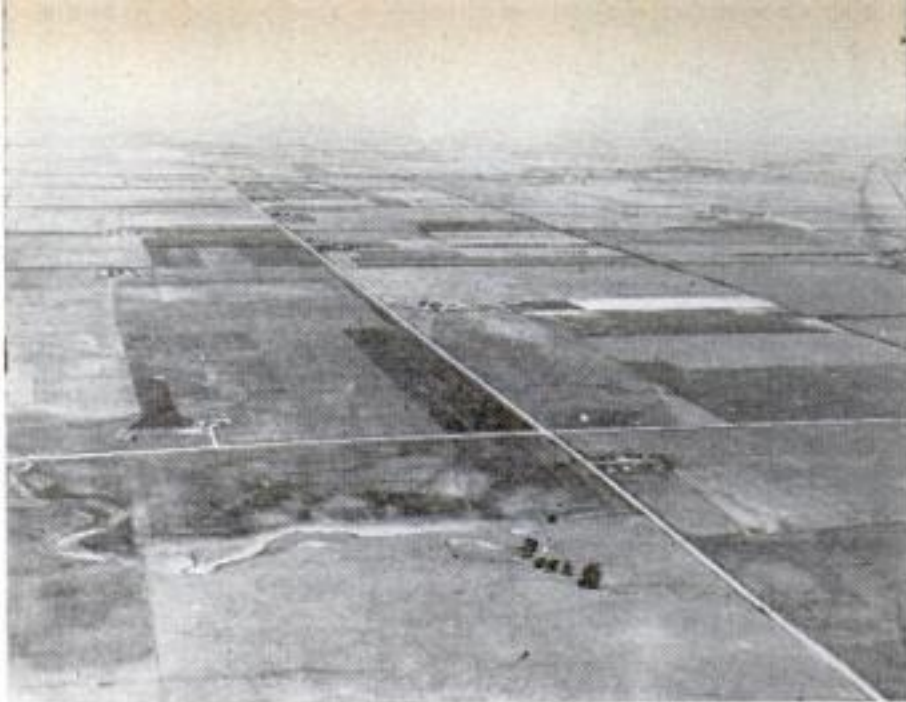
While we were not overloaded with luggage, we had ample room for our bags, fishing rods, and camera equipment. Our map case fitted snugly behind our heads on top of the baggage compartment. The only additional weight we carried was a two-way radio. We had experimented with it and decided that it lacked the range for us to use it for radio navigation—following the "beams" that the commercial airliners use. That was a mistake, as we were later to discover.

Our first refueling stop would be Harrisburg, Pa., 162 miles away. We had agreed to avoid the big terminal airports wherever possible and use the smaller fields catering to private flyers. Circling a big airport awaiting landing instructions takes time. Time means gasoline. None of the small



REPAIRS. A leaky carburetor gets expert attention at Parks-Hoosier airport, Indianapolis. Here the travelers found the kind of service for air motorists that the whole country is going to need.

CONTROLS of a lightplane are a little more complicated than those of an automobile. On the Chief, a steering wheel replaces the "stick" for more leg room. Additional controls are recessed on bottom edge of panel.



LEVEL COUNTRY in the Middle West, with few recognizable landmarks to guide the "contact" navigator, makes it extremely difficult to steer a direct course from one point to another. Francis and Groenhoff got themselves completely lost over country like this near the Kansas-Colorado line, when they had to leave their course because of a storm.



SMOKE from factories or fires on the ground proves useful for showing the direction and velocity of the wind. "Drift" is an important factor in aerial navigation, as it carries the plane to one side or the other. Many lightplane flyers "dead-reckon" their course in advance, allowing for wind and the compass variations.

fields we would use would have control towers directing traffic by radio. While Harrisburg had a control tower, it was only a medium-sized field. Moreover, it was right on our course.

We climbed in, I in the left seat and Groenhoff in the right. For this first leg of the trip I would fly, he would navigate.

"All set?" I asked, as we parked at the take-off end of the runway with the engine ticking over.

"All set."

I wheeled into the wind and opened the throttle. Plane and ground became unstuck. Off the end of the field I inched back on the throttle to reduce the engine's 2,500 take-off revolutions to 2,200 for cruise.

STRAIGHT ROADS running east-west or north-south across the Middle Western prairie were handy navigational aids. Crisscrossing the country like meridians of longitude and parallels of latitude on a map, they gave the pilot a beeline to his landing place if he could find one that was going his way.



"All right, where?" I asked Groenhoff. "Try 267 degrees and we'll see whether there is any wind up here to drift us off course."

There are several ways of navigating a light airplane in "contact" flying—that is, flying by visual reference to the ground. Many flyers "dead-reckon" their course in advance, arriving at a compass reading by compensating true north with magnetic variation, wind drift, and the deviation of the needle due to metals in the plane itself. We chose a modification of the system. We would start out on a given compass reading and then correct for error if we found we were off course.

I put the plane *(Continued on page 202)*

CROOKED ROADS, like this one in Missouri, were not much help. Winding as they followed the contours of the terrain, they would take the flyer all around Robin Hood's barn. In such country, there was nothing to do but go back to dead reckoning for getting the course.





CLOUD SHADOWS gliding across the landscape also serve as a natural wind sock. Wind directions and speeds are included in Weather Bureau reports, but they soon are outdated by changing conditions. The Popular Science flyers always figured their compass course in advance, then corrected it as they went along.



LOCAL FLYERS are the best source of information and advice on flying conditions. They know what they are talking about. Here an officer of the Civil Air Patrol is advising Greenhoff to avoid some 7,000-foot terrain that spoons out into the prairie east of Colorado Springs. As it happened, weather forced the air tourists right across that troublesome spot.



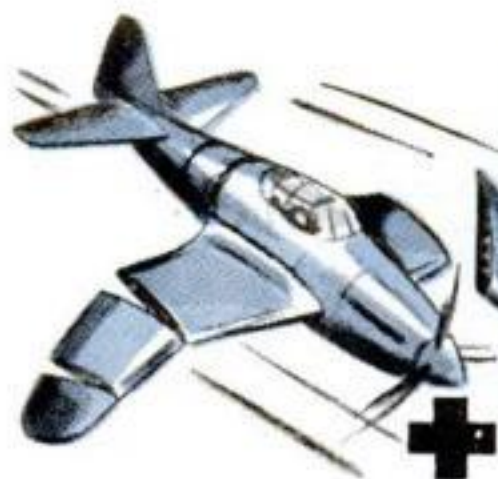
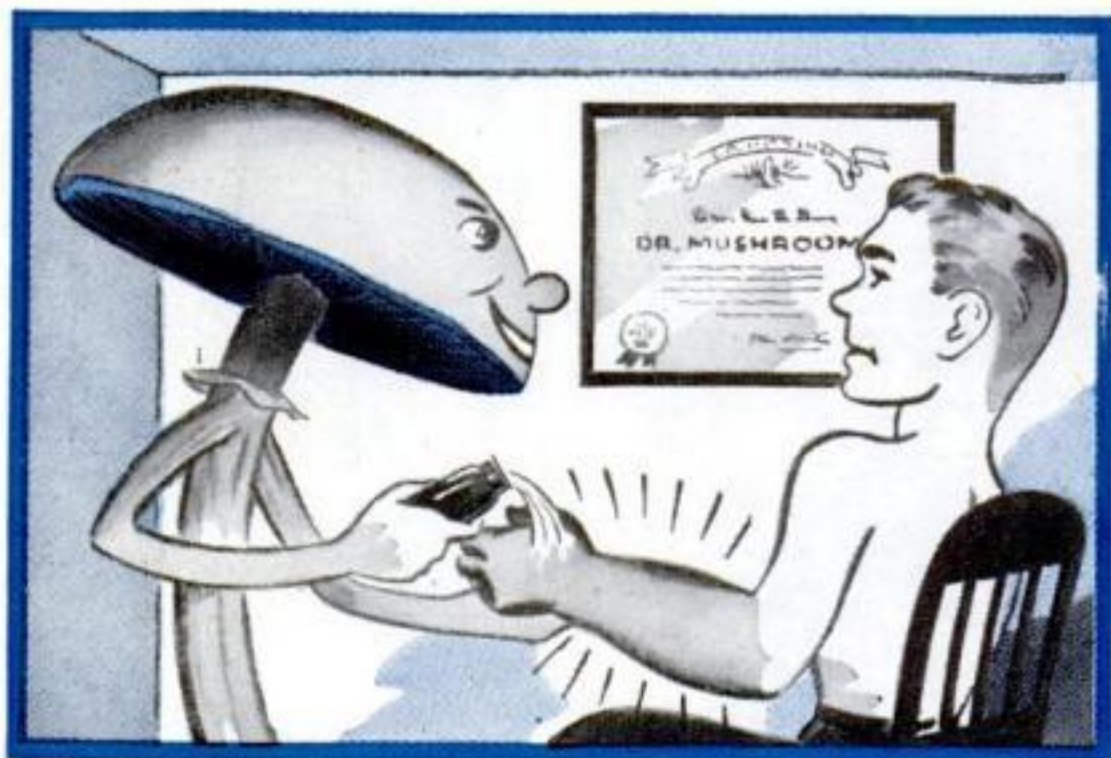
WEATHER is the big "if" in lightplane touring. To the automobile vacationist, a storm means discomfort or inconvenience; to the pleasure flyer, it means changing his course or staying on the ground until the skies clear. However, if he can forget the threat to his safety and his plans, the airman can see awe-inspiring spectacles in storms. A characteristic thunderstorm cloud formation is the cumulonimbus seen in this remarkable picture, one of the few photographs of its kind snapped from the air.



MARCH

STEEL HOSIERY? There's a possibility, even a probability, that women's legs will soon be encased in stainless-steel stockings. At least, that idea was projected recently by an engineer in the steel industry when speculating on new uses for steel in the postwar era. He points out that some steel companies have been producing stainless-steel wire that compares in diameter with the threads used in the finest silk and nylon hose. The transparency of a filter cloth made of these fine wires is shown in the photograph. Maybe there's a postwar job in view for Welding Wanda—repairing runs in stainless steels.

POISON-IVY VICTIMS may soon be blessing the humble mushroom, if tests being conducted at the Massachusetts Institute of Technology prove successful. Prof. Irwin W. Sizer and Clemens E. Prokesch have discovered that when tyrosinase, an enzyme found in mushrooms, is mixed with ivy poison and applied to the skin, little irritation results. If it is found that the mushroom extract works equally well when applied after the ivy has attacked the skin, it may replace harsher agents now used in salves and ointments.



Aluminum-bearing liquor is pumped into precipitating tanks. When it stands and cools, crystals of aluminum hydroxide soon settle out.

The crystals are removed and washed. Then they are heated white hot in kilns, producing aluminum oxide.

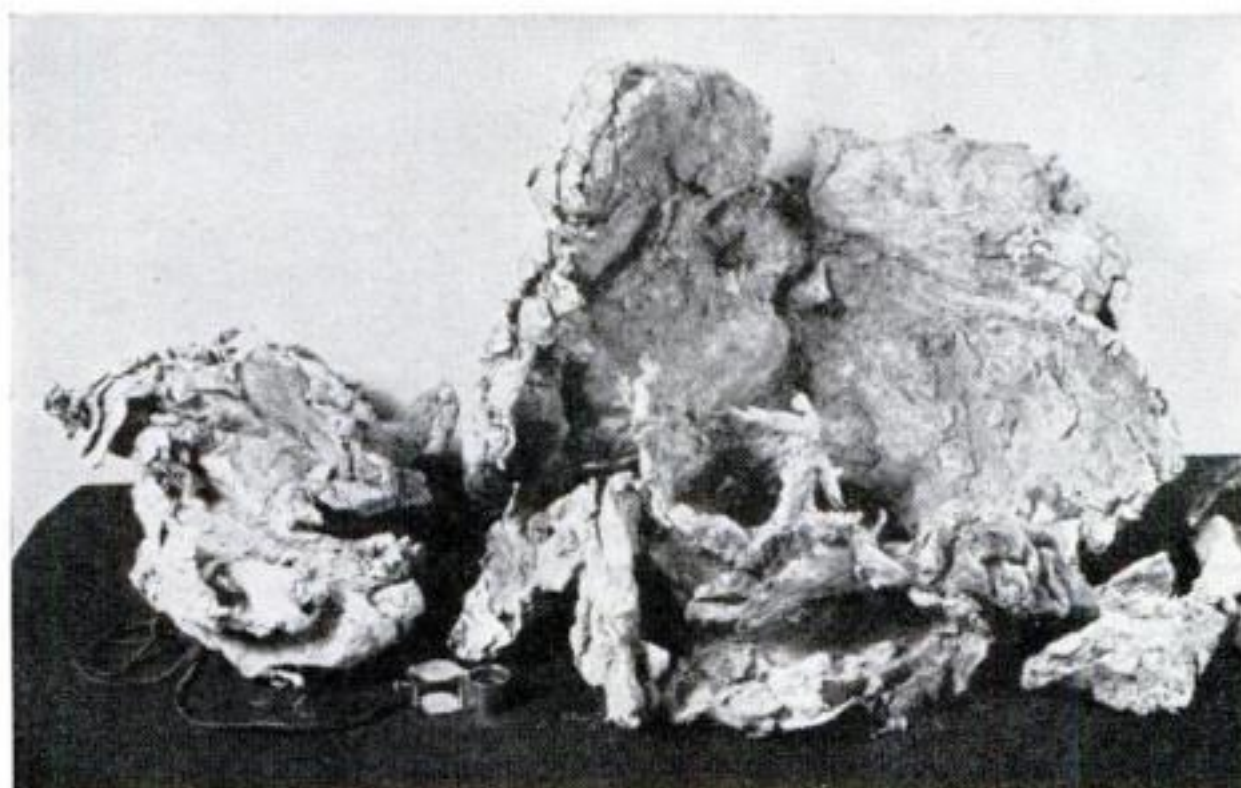
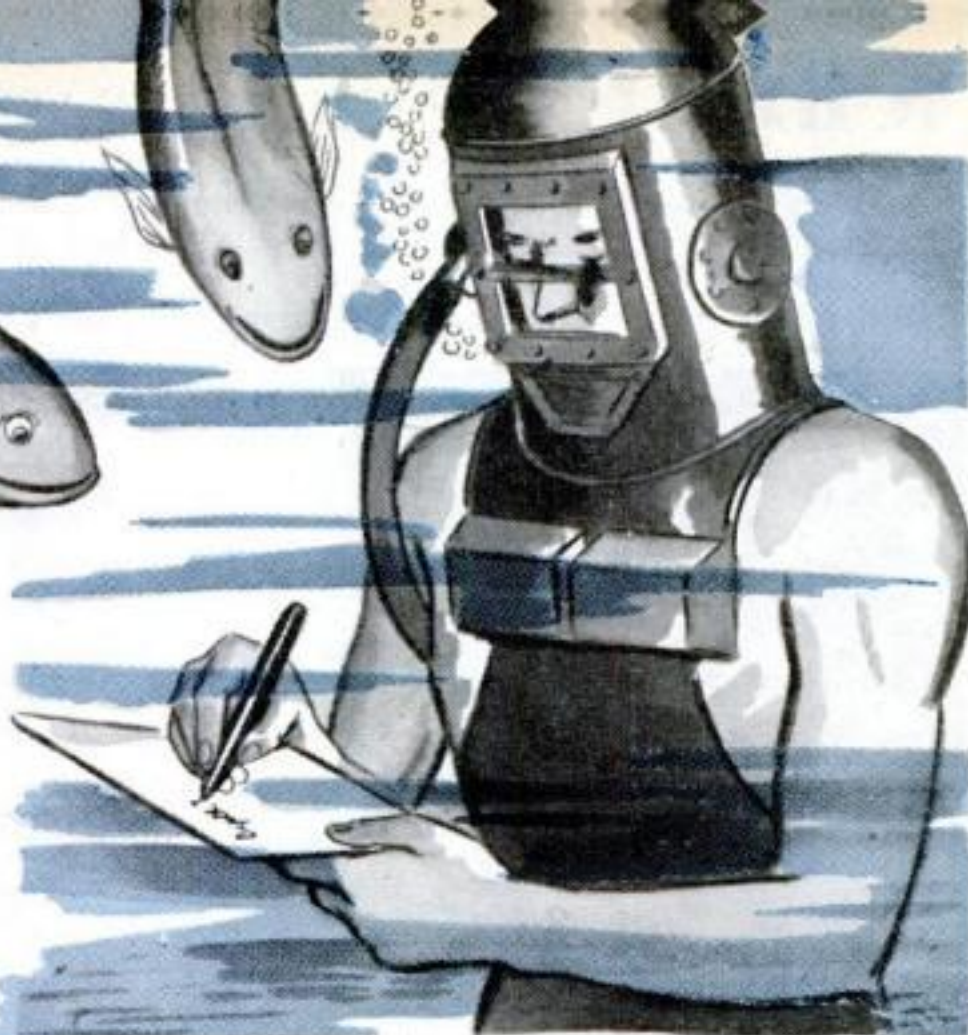


SCRAPPED PLANES now yield pure aluminum by means of a process developed by Alcoa in conjunction with the AAF. Chopped-up airframes are given a caustic soda bath which dissolves only the aluminum, leaving the non-aluminum parts in solid form. Then the aluminum hydroxide crystals are captured and heat-treated to drive off moisture, yielding pure aluminum oxide.





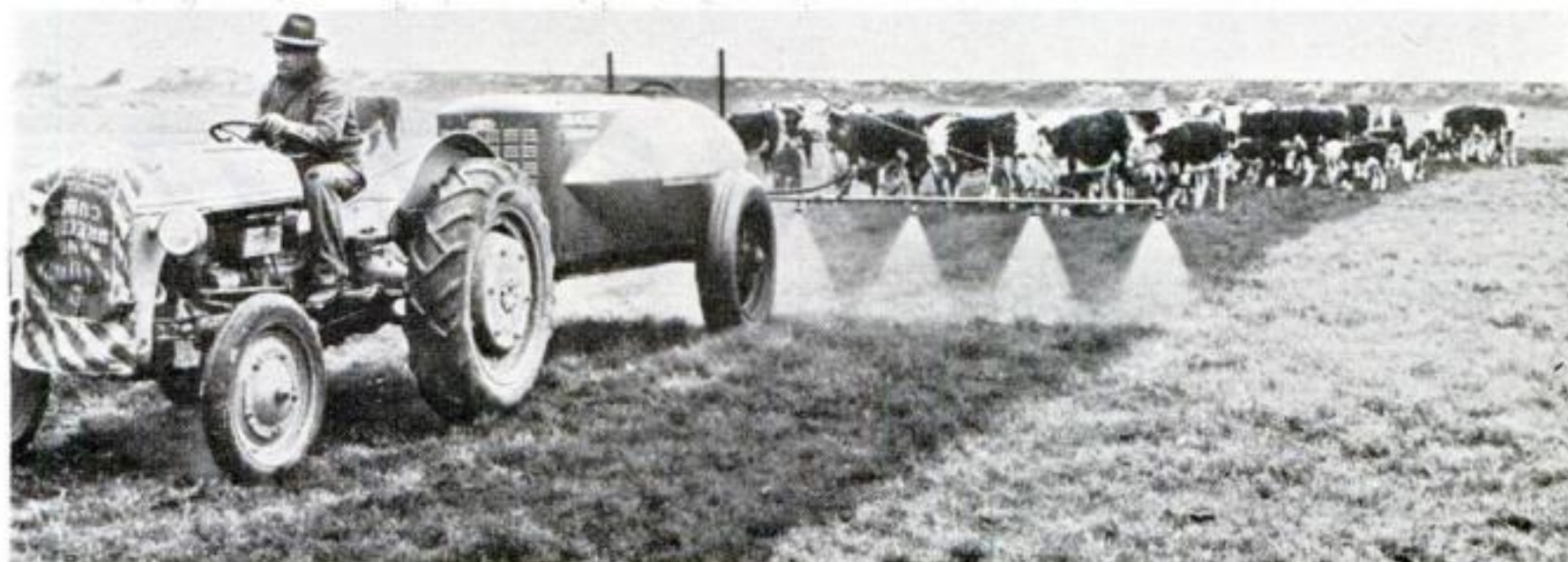
WRITING UNDER WATER or at 50,000 feet, on cloth or any kind of paper, is possible with a revolutionary new fountain pen (P.S.M., Jan. '45, p. 113) made by Eversharp and by Eberhard Faber. Its ball-bearing point is fed instantly drying viscous ink from a cartridge holding a year's supply, to be obtainable anywhere when the pen is sold to civilians after the war.



MOUNTAIN LEATHER, a type of asbestos that has been only a museum curiosity in the past, has been discovered in a large deposit on Lemesurier Island, Alaska. Experiments conducted by the U. S. Bureau of Mines reveal that the acid-resisting and fireproof material—paligorskite to geologists—is adaptable to industrial uses, especially for filtering, soundproofing, and shock-absorbing purposes. When wet, it resembles paper pulp.

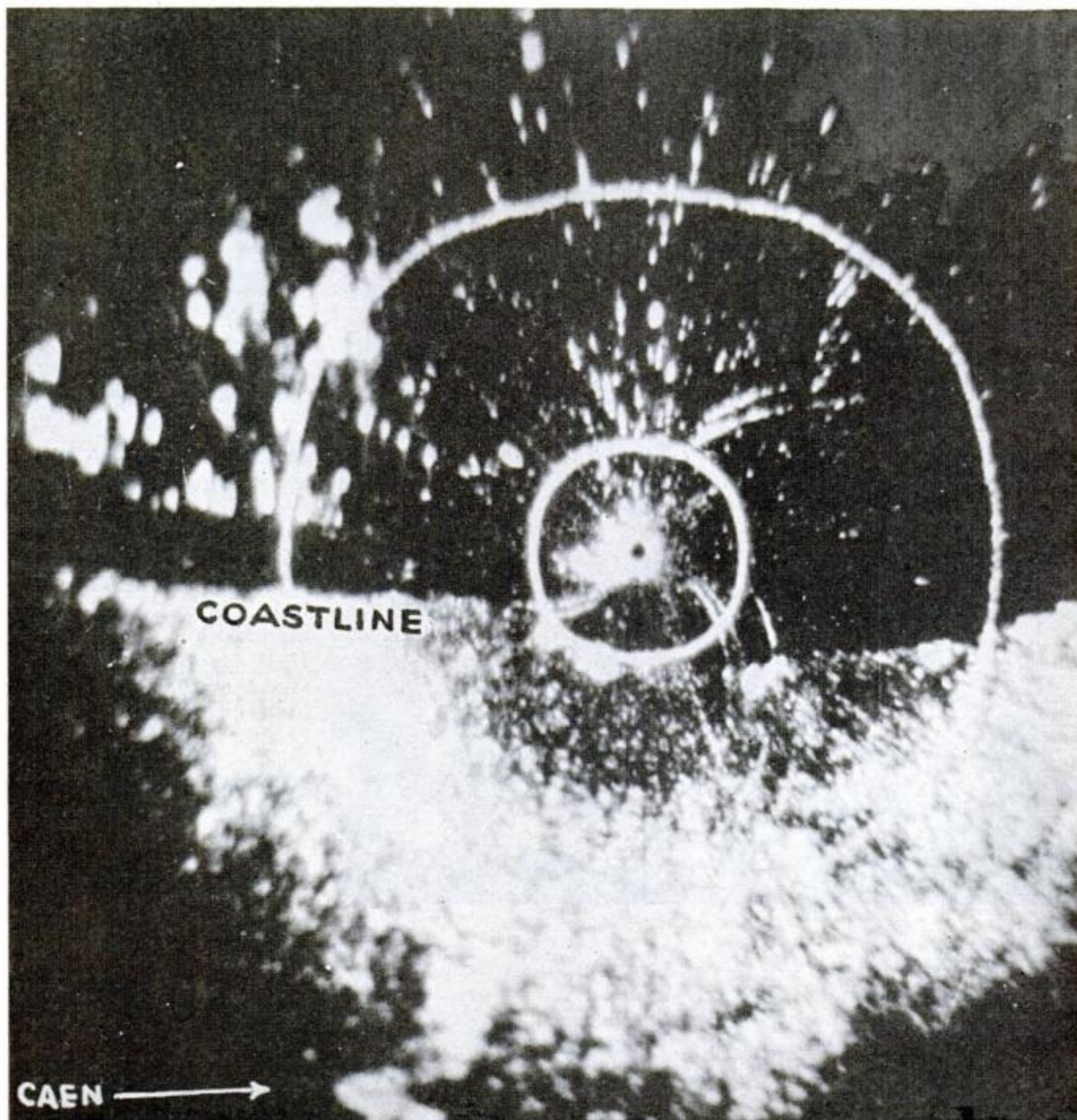
TASTE APPEAL is added to salt grass and old hay by spraying it with a solution of one third water and two thirds molasses. The otherwise unpalatable diet of range cattle becomes a tempting dish during the dry

season when cattle do not easily graze. Moreover, it increases the weight and milk production of a herd. The power sprayer shown, made by Food Machinery Corp., covers a 20-foot-wide swath.



What Flyers See on RADAR Screen

The magic of radar permitted Allied airmen, unseen by the enemy below, to "view" the Normandy coast from above thick clouds before and during the invasion of June 6, 1944. Using an advanced development of radar which traces a picture of the scene below, the operator could see in his viewing screen the coastline and built-up areas of towns. In the picture below, the blobs of light are invasion ships.



Now It Can Be Told!

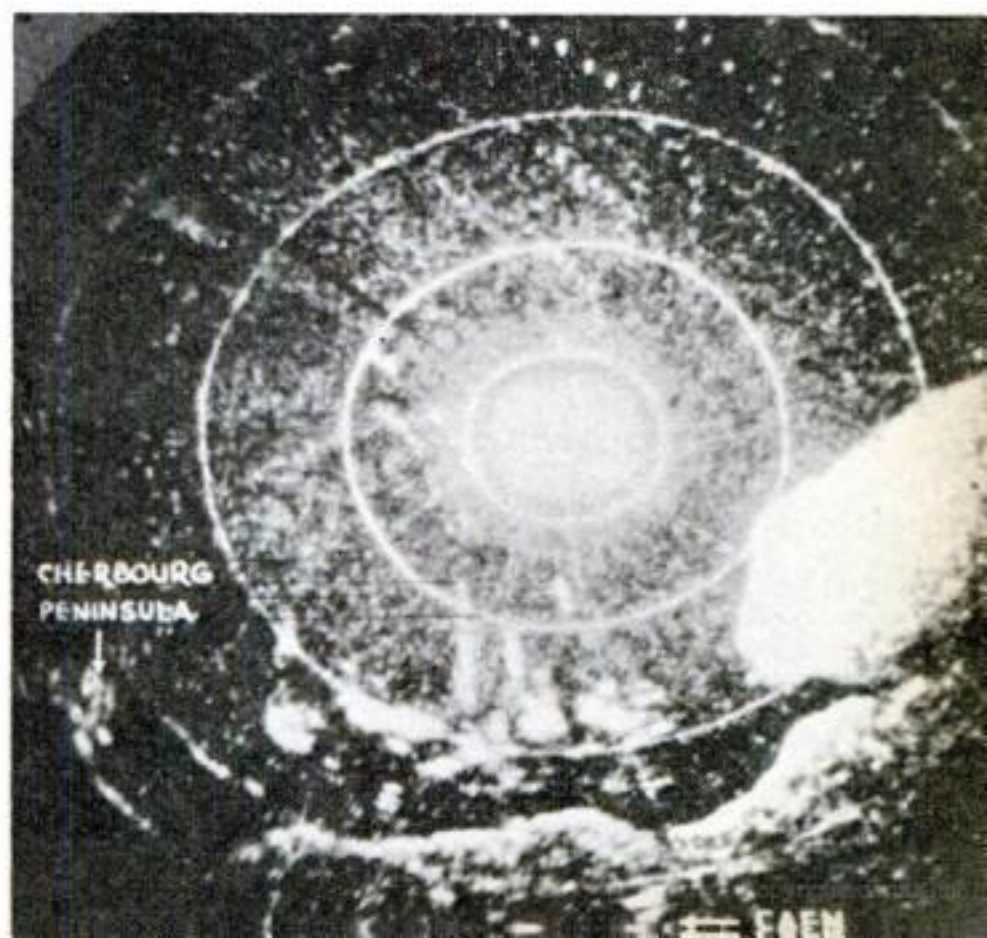
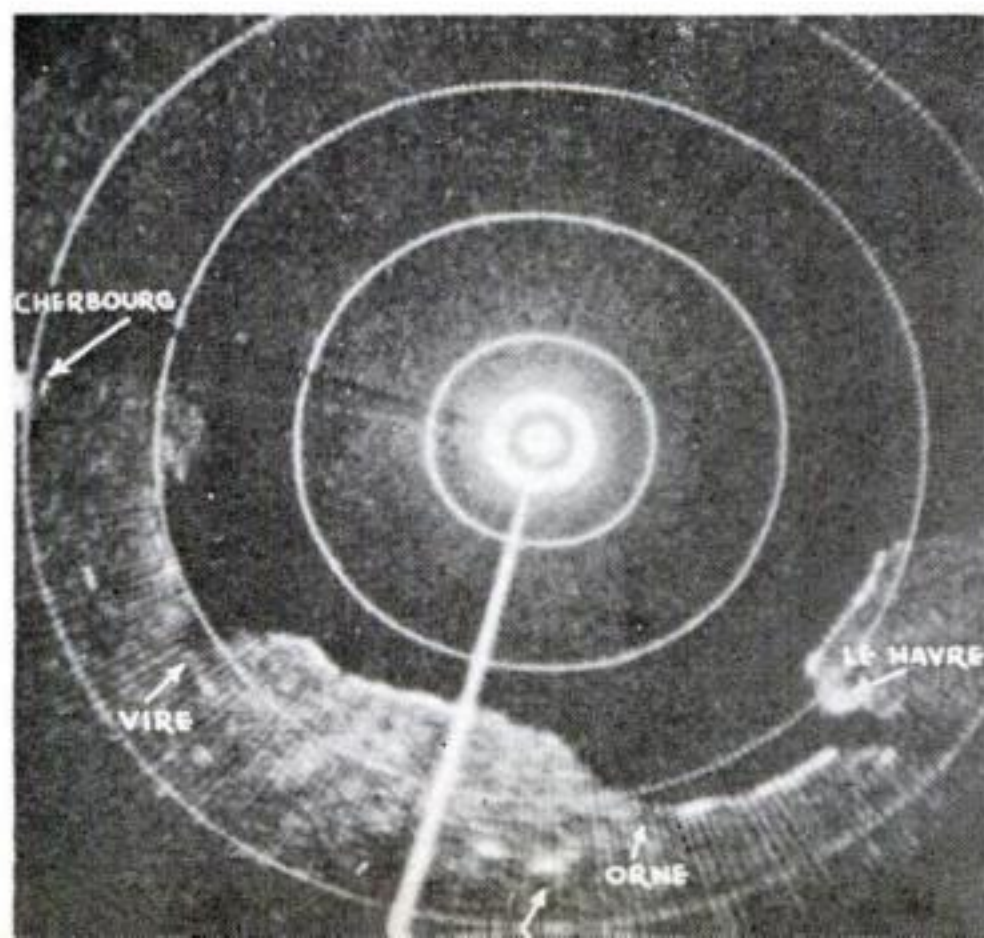
*8 Pages of Pictures Showing in Detail the
Secret Devices Developed by American and
British Military Engineers to Beat Germany*



Here is a magnified, exact picture of a small part of the coastline and offshore area which the radar operator gets merely by turning a certain switch. The position of the plane is indicated by the bright spot in the center of the small black ring. In this close-up view, swarms of small Allied assault craft merge into a big blob of light, with smaller grains surrounding it. Even though the pilot and bombardier can see nothing, the radar operator can tell them exactly where they are and when to drop their bombs.

The Normandy beaches looked like this in the radar viewing screens of Eighth Air Force reconnaissance planes on pre-invasion flights. The coast is clearly outlined. The concentric rings serve as a fixed scale for measuring distance. The straight line is a rotating scanner beam.

Flying toward France, the plane is 35 miles from the coast at this point. Radar reveals some invasion boats already hugging the shore. These pictures, recently released, first appeared in *Impact*, an Air Forces magazine.



"PLUTO"-The Undersea Pipe Line

ONE of the engineering triumphs of the war was "Operation Pluto," the laying of 20 pipe lines under the English Channel to supply gasoline to the Allied armies that crushed Germany (P.S.M., July '45, p. 70). Details of this achievement have just been made public.

Four pipe lines stretch from the Isle of Wight to Cherbourg and 16 from Dungeness to Boulogne. For this stupendous undertaking, two types of tubing were used. One, the Hais, is based on the pattern of undersea electric cable, but has a hollow lead-pipe tubular center three inches in diameter; the other, the Hamel, consists of three-inch steel pipe with $\frac{1}{4}$ -inch walls that could be welded easily into any required length.

To obtain enough of the Hais tubing, the British Petroleum Warfare Department called on the U. S. Army to produce 140 miles of it. Col. A. K. Eaton, of Scarsdale Manor, N. Y., who was in charge of the project, assigned the task to four American firms, among them the Phelps Dodge Copper Products Corp. of Yonkers, N. Y., and the General Electric Company, and in a matter of months the cable was in England.

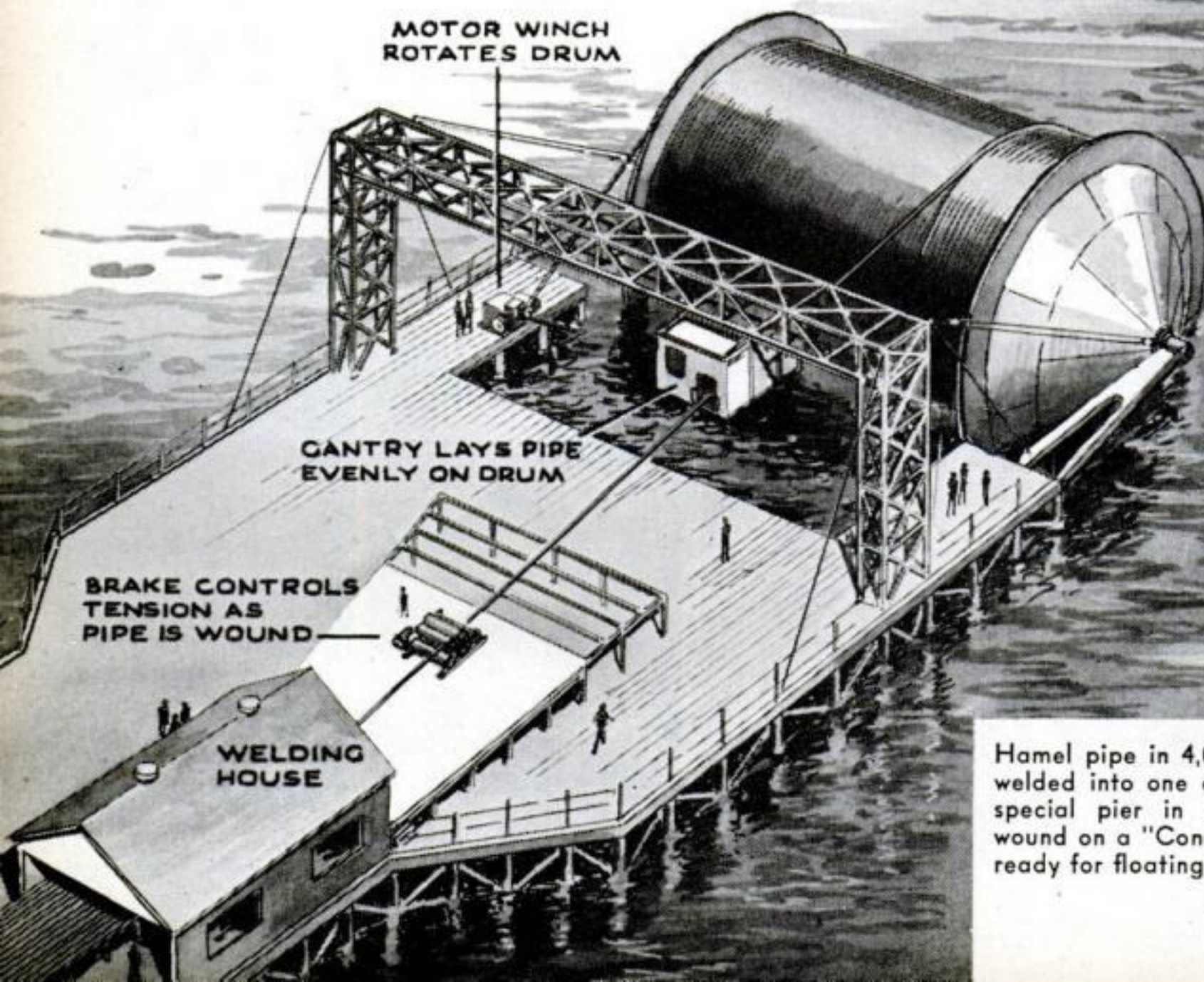
The Hamel pipe, all of which was made in England, could be wound on a drum like cotton on a spool and pulled off again relatively straight, provided the drum's diameter was greater than 30 feet. It was decided to make these giant bobbins, known as "H.M.S.

Conundrums," over 50 feet in diameter and 90 feet wide, with flanges six feet high. Empty, each weighed 270 tons, but with 70 miles of pipe the weight zoomed to 1,600 tons.

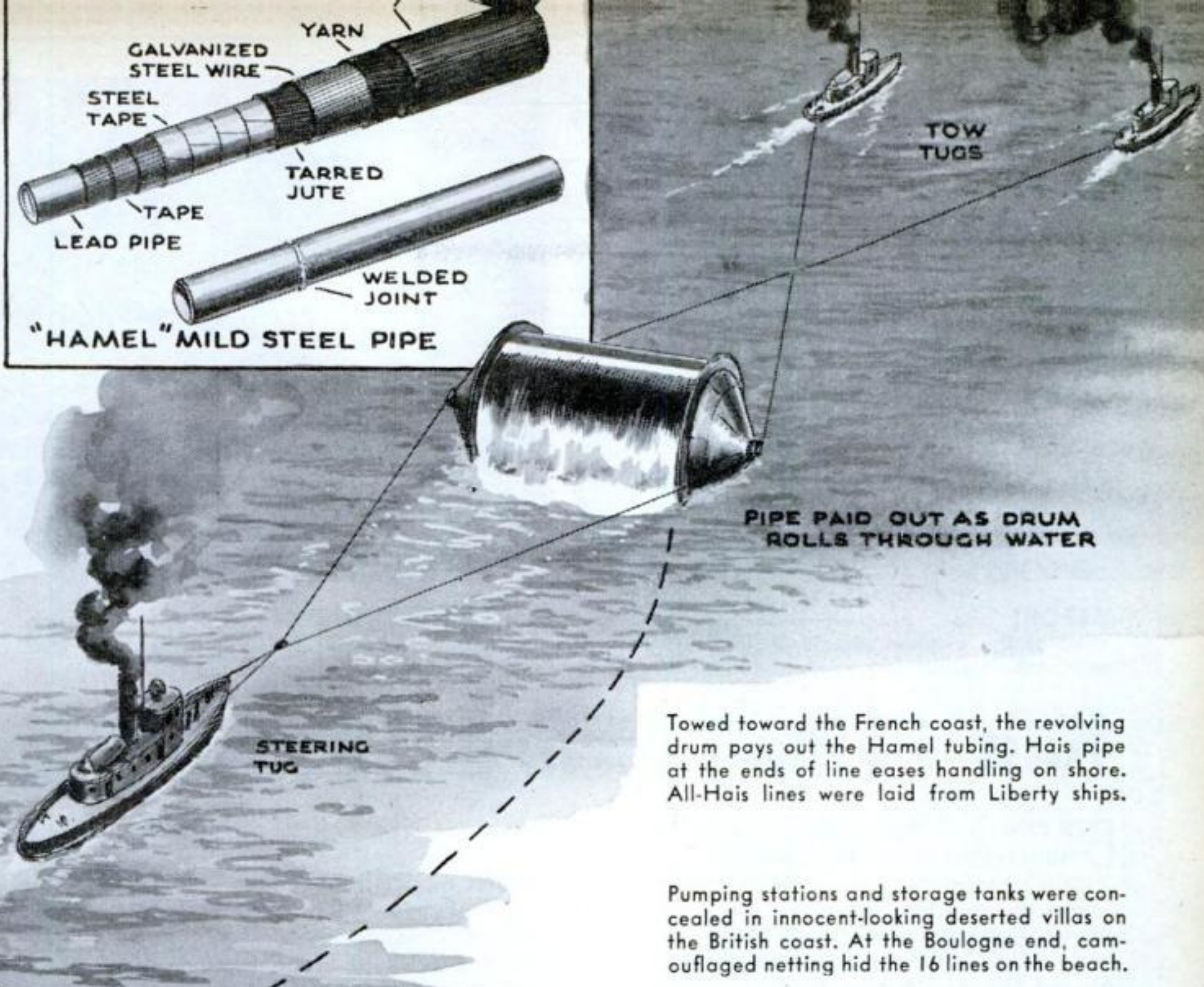
Twelve of the 20 lines were composed entirely of Hais pipe. This was laid by coiling it in the holds of Liberty Ships and paying it out over drums on the hatches.

Operation Pluto began a few weeks after D Day, as soon as the mines had been swept from the approaches to the tip of Cherbourg Peninsula. After Boulogne was captured, the Dungeness-Boulogne route was established. Each line to Cherbourg took 10 hours to lay, but the shorter lines to Boulogne were put down in five hours apiece. Cleverly concealed pumping stations on the British coast soon began to push the fuel through the underwater pipes. As the Nazis were forced backward, the Royal Army Service Corps laid overland extensions to Antwerp, to Eindhoven, to Emmerich, and soon 1,000,000 gallons of fuel a day were gurgling to the Rhine.

Redrawn from Illustrated London News

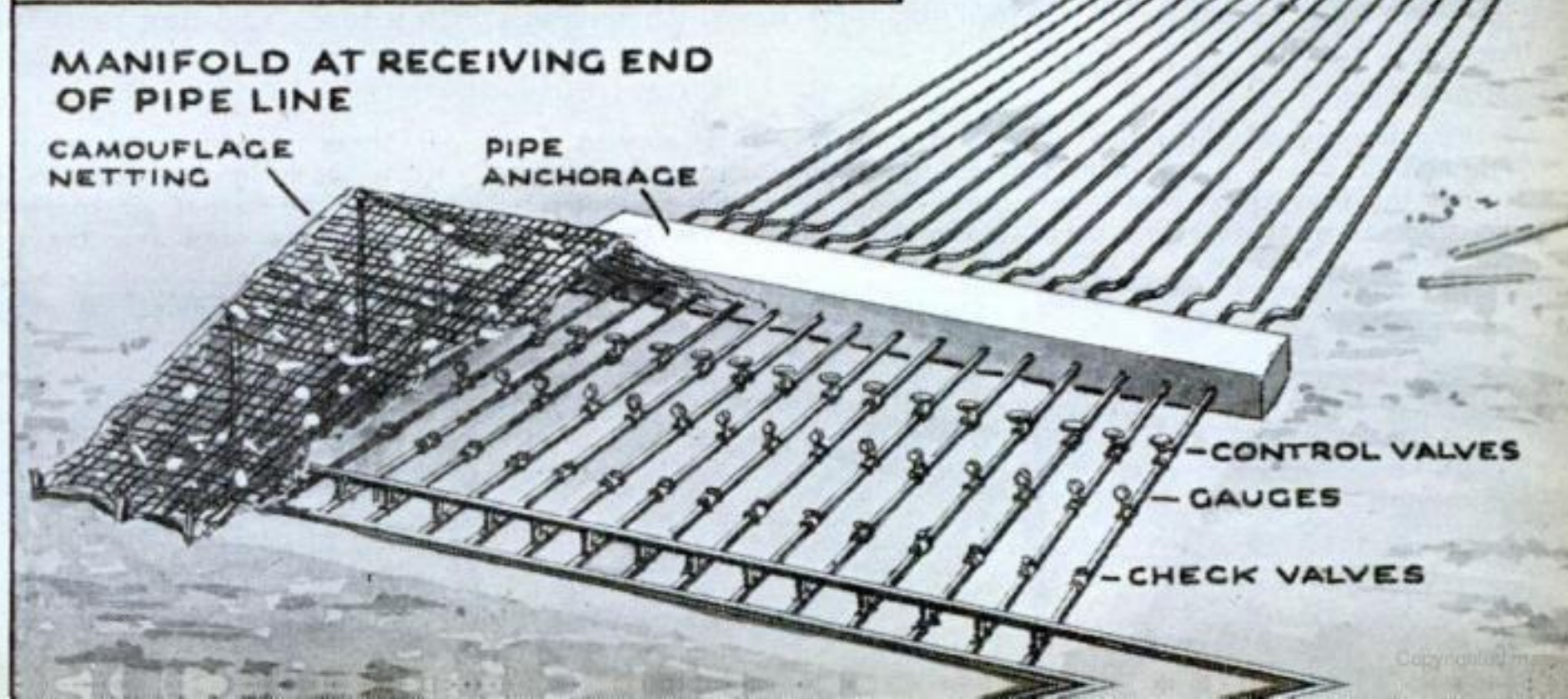
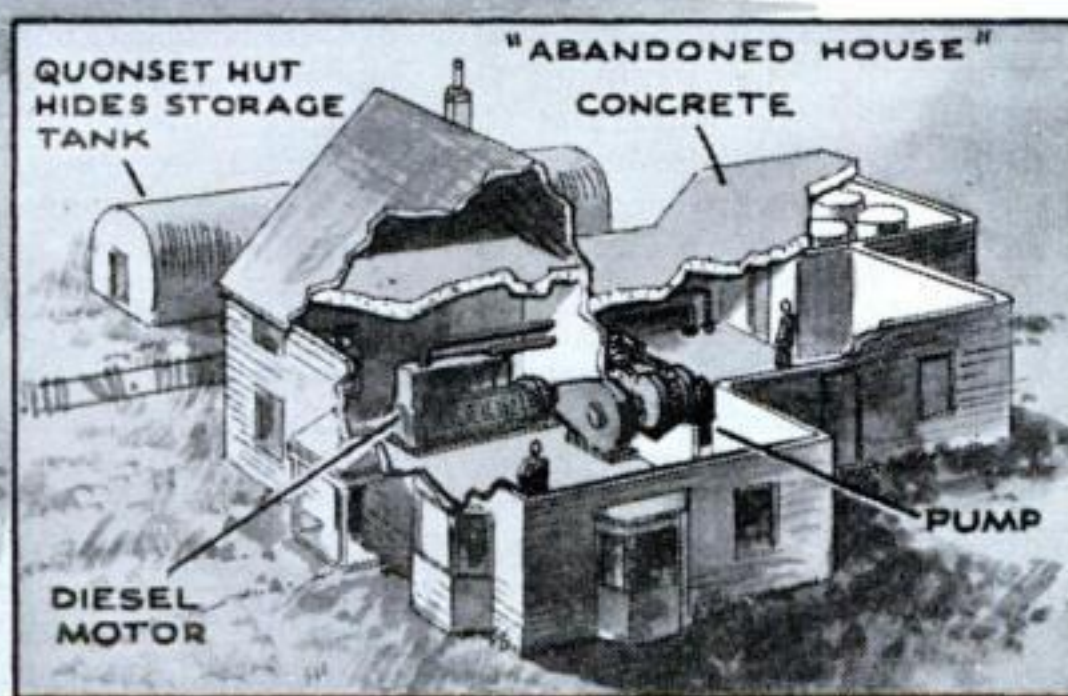


Hamel pipe in 4,000-foot lengths was welded into one continuous line on a special pier in Britain while being wound on a "Conun." Reels were then ready for floating across the Channel.



Towed toward the French coast, the revolving drum pays out the Hamel tubing. Hais pipe at the ends of line eases handling on shore. All-Hais lines were laid from Liberty ships.

Pumping stations and storage tanks were concealed in innocent-looking deserted villas on the British coast. At the Boulogne end, camouflaged netting hid the 16 lines on the beach.





BEFORE "Fido," conqueror of the weather, is applied at this bomber base in England, visibility is near zero. A soupy fog envelops the landing field.



AFTER burning only nine minutes, Fido's vaporized-petroleum burners have raised the temperature enough to dry up the fog, clearing the runway area.

How "Fido" Licked Airfield Fog

BRITISH scientists, pilots, meteorologists, and engineers had an answer for Mark Twain's statement that everyone complains about the weather, but no one does anything about it. That answer was FIDO (Fog Investigation Dispersal Operation), which conquered the weather in limited areas at air bases and was another vital achievement in helping to pulverize the Wehrmacht and lay waste German cities.

Fido revolutionized air war. It enabled 2,500 bombers to operate from one Continental and 15 British fogbound airfields, made possible the bombing of Berlin 36 nights in succession, and put our bombers in the air against Rundstedt's desperate offensive in the Battle of the Bulge last December when the Western Front was enveloped in intense fog.

Fido succeeded where experiments with supersonic waves, electrical discharges, absorption of moisture by chemicals, drying by refrigeration, and outdoor air-conditioning apparatus failed. Fido provides the

necessary heating to disperse fog by a continuous line of petroleum burners installed parallel to and some distance from each airstrip. Flames spurt two feet high from thousands of tiny jets in the pipes, burning with a fierce, white-yellow glare. The atmospheric temperature is raised, causing the water droplets to evaporate. The height of the clearance depends upon the wind and the moisture content of the fog. Sometimes it is difficult to get good clearances up to 100 feet, but even this limited gap enables planes to come in during the worst weather.

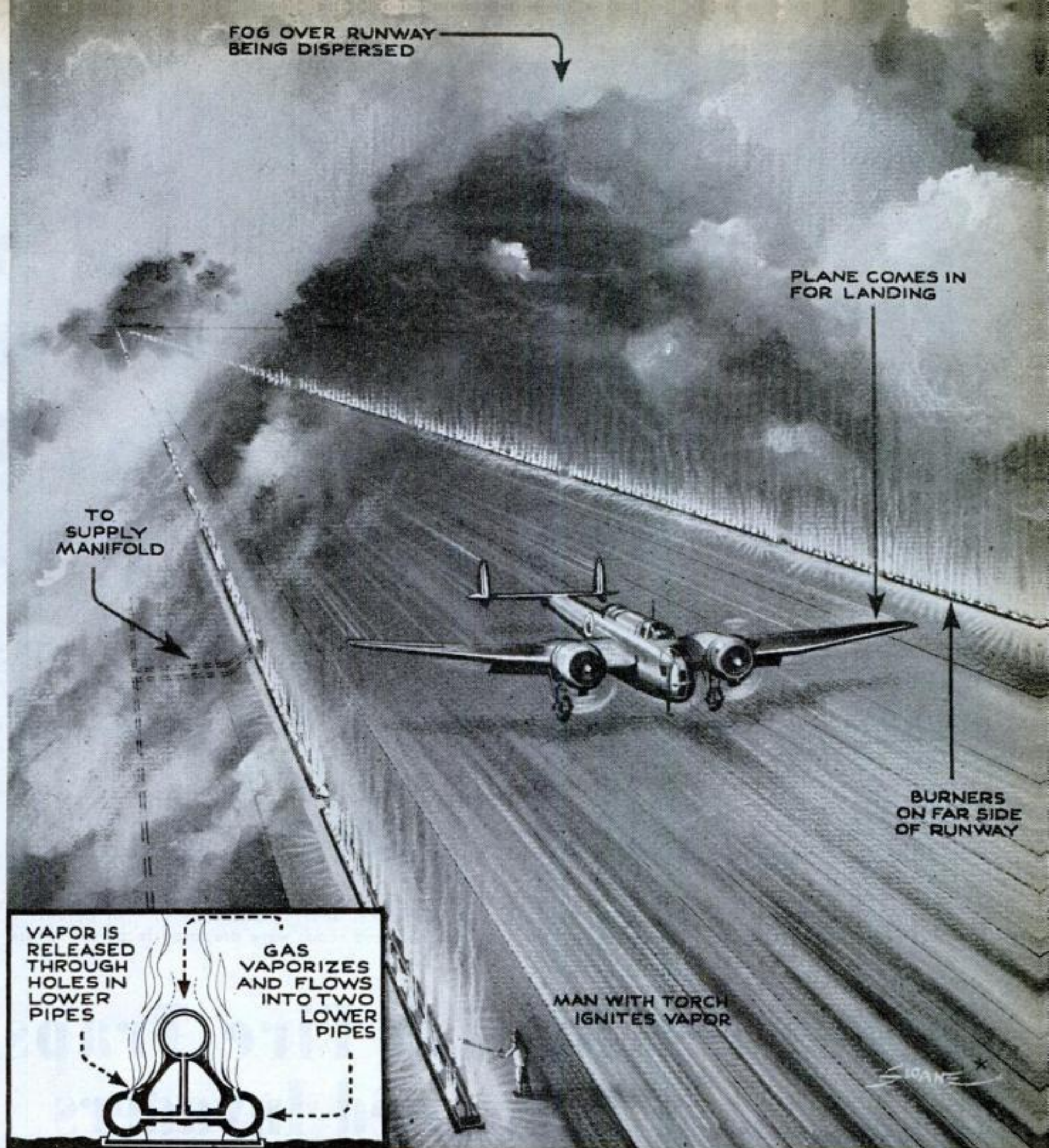
A standard fog-dispersal installation consists of three main parts—burner lines, pumping and distribution units, and storage facilities. Three burner pipes—two on the ground and one above—cover an area of 2,000 by 150 yards. Oil pumped into the upper pipe flows down into the lower pipes, which are the ones with the thousands of tiny holes. A man walking along touches these holes with a torch, igniting the vapor-

If there is no wind, the effect of lighting up one line of burners is that the rising heat clears the fog from above burner line only.

If a cross wind is blowing from the burner line toward the runway, the rising heat will be directed toward the fog above the runway.

If there is a parallel wind, or calm, both lines of burners are lighted. Rising hot air converges, clearing the area over the strip.





Fido's triple pipe line flanking a landing strip is 1,000 yards long on each side, 500 yards of it in the approach and 500 on the runway. In equipping intersecting runways, lines are sunk flush with ground.

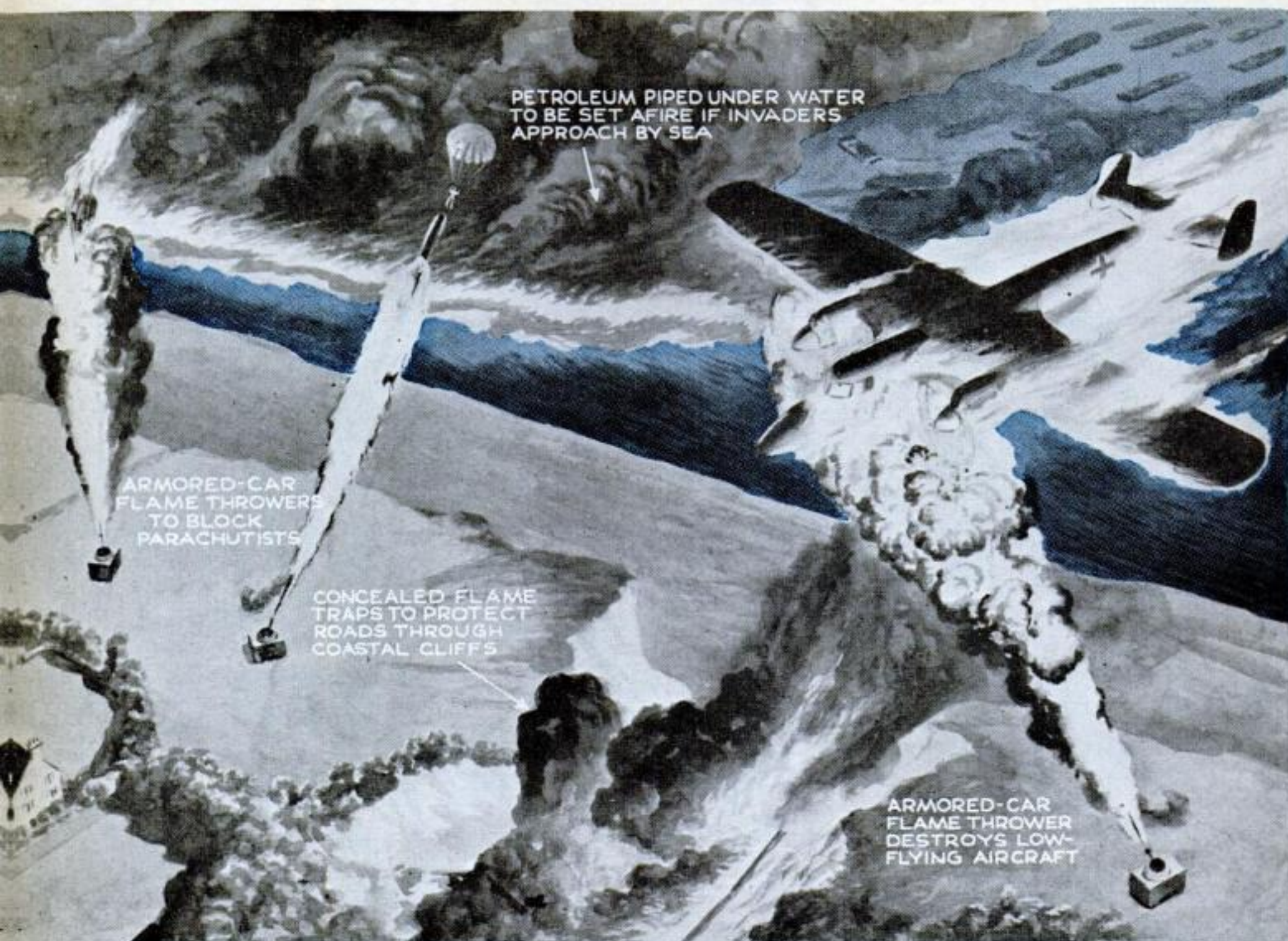
ized petroleum. Under normal conditions, the fog can be cleared in 10 minutes. It has been shoed away in six minutes.

When intersecting runways are equipped, burner pipes sunk flush with the ground are necessary, so that there will be no obstructions to aircraft using the strips when there is no fog. Separate vaporizing units supply these pipe lines.

The main fuel-handling pumps are six gasoline-engine-driven centrifugal pumps connected to the supply main from the stor-

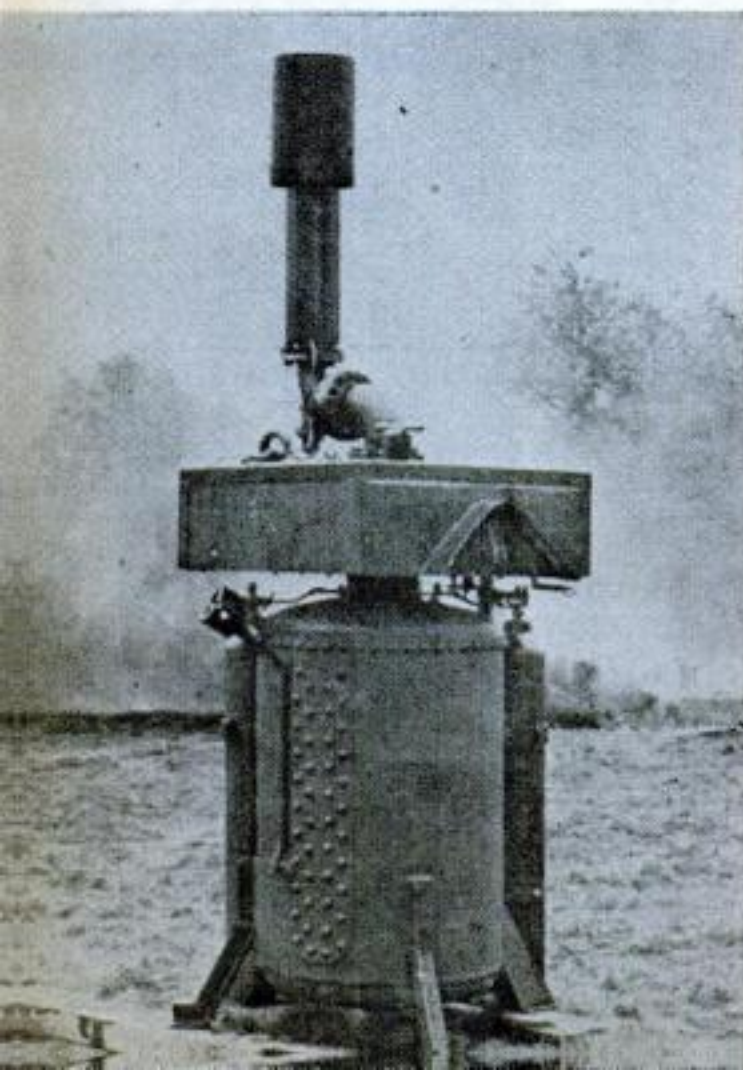
age tanks and the delivery main to the burner pipes. Each installation is run by 21 men.

The first operational use of "Fido" took place on Nov. 19, 1943, after a little over a year of experimenting. A special Fido project to aid peacetime air transport is now being constructed at Heath Row, Middlesex, England, which is to take the place of Croydon as an airdrome. There an area of 3,700 by 200 yards will be cleared of fog by burning oil.



A barrier of flame would have met the Germans had they invaded Britain during the perilous days after Dunkirk. British troops had left most of their weapons in France, and the backbone of their defense in 1940 was burning petroleum. The surface of the sea, beaches, and roads were prepared to be set ablaze.

This vertical flame thrower can be used on land or from a ship's bridge. Britons had it ready to burn Nazi gliders and paratroops.

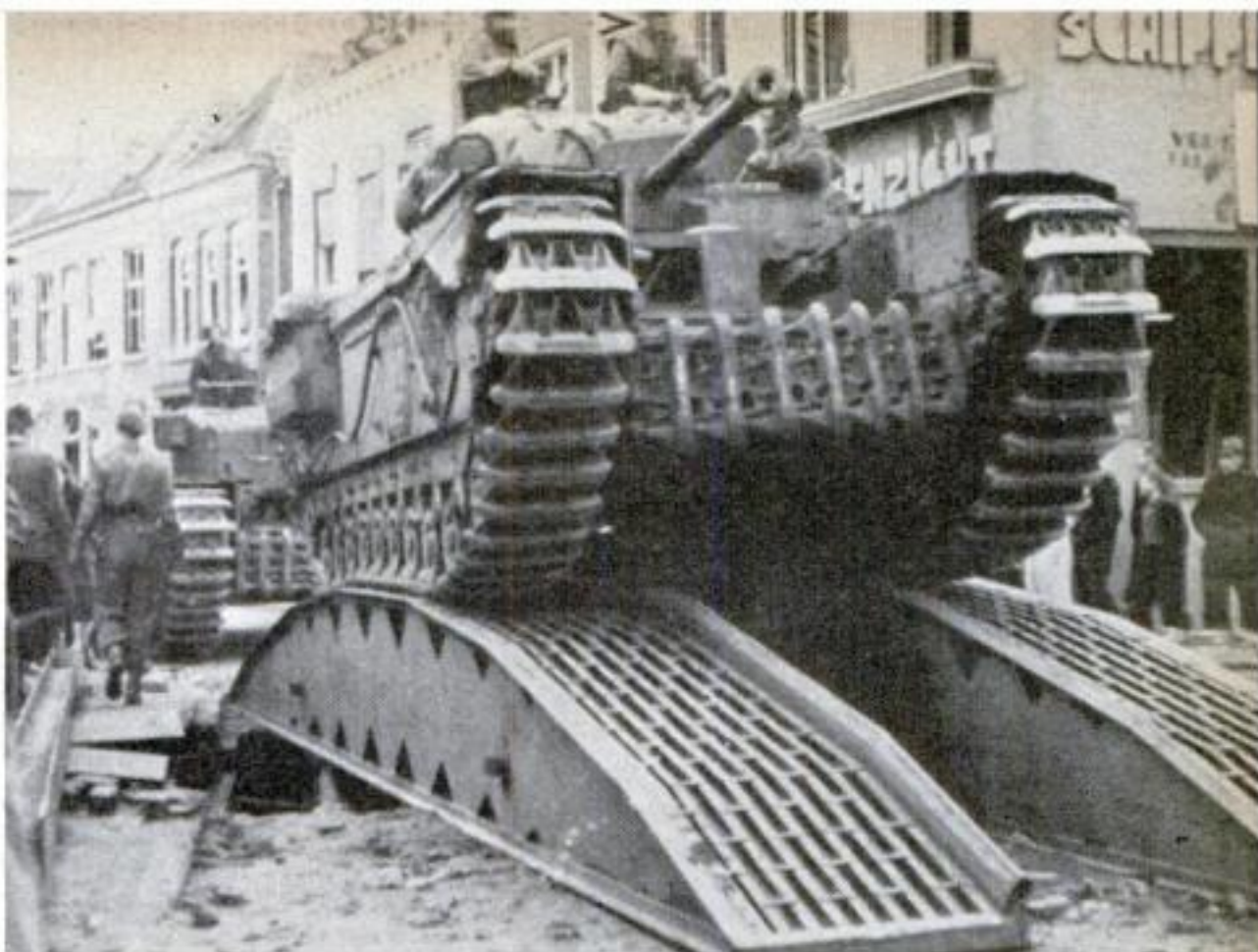


British Fire Traps Awaited Invaders

A HOT reception was planned inland and along the coasts of England for any German invaders who might have tried to set foot on English soil. The British were prepared to throw up instantaneously a wall of raging flames on land, at sea, and in the air.

First, the waterborne Nazis would face a sea-fire barrage—a belt of flame formed by merging patches of oil pumped 250 feet into the sea through underwater pipes and set afire by calcium phosphide. On the beaches, header pipes were installed underground. Each had four nozzles which stuck above the surface and could pour forth burning oil. Tanks and pump stations were hidden on cliffs.

Other defense equipment included 60-gallon tanks of gasoline which, when electrically fired, would throw a flame 30 yards; hedge-hopping drums of gasoline that would form rivers of fire on roads; and flame-throwing guns designed to spurt liquid fire 100 yards at gliders and paratroops.



A Churchill bridgelaying tank threw its span across this anti-tank ditch in 10 minutes in the assault on Roosendaal, Holland. Upper left, the hydraulic arm raises the trackway high over the tank hull and sets it across the street crater. Tank is disengaged (left), after which a column of combat tanks rolls onward.

Tank Bridges Speeded Victory

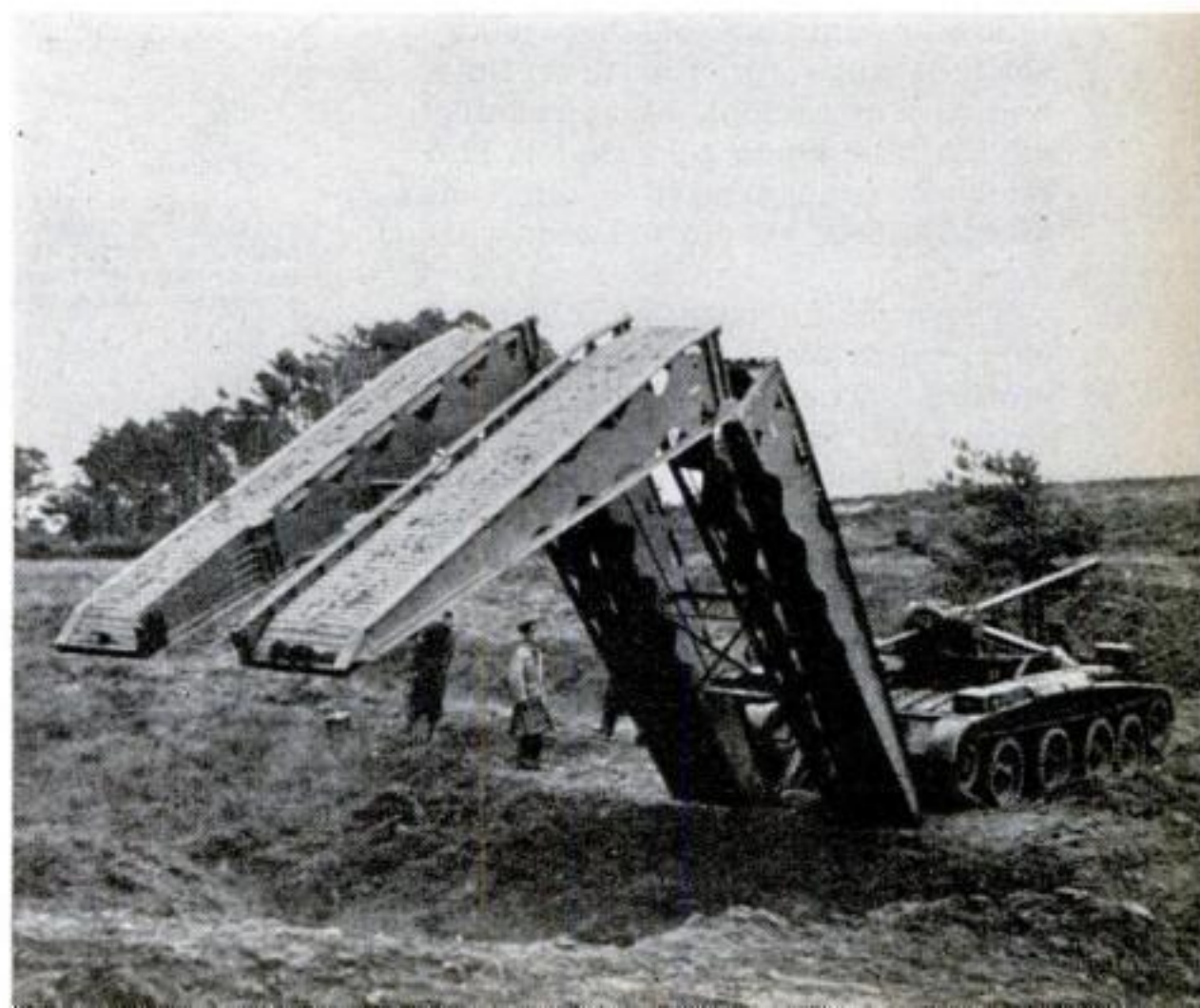
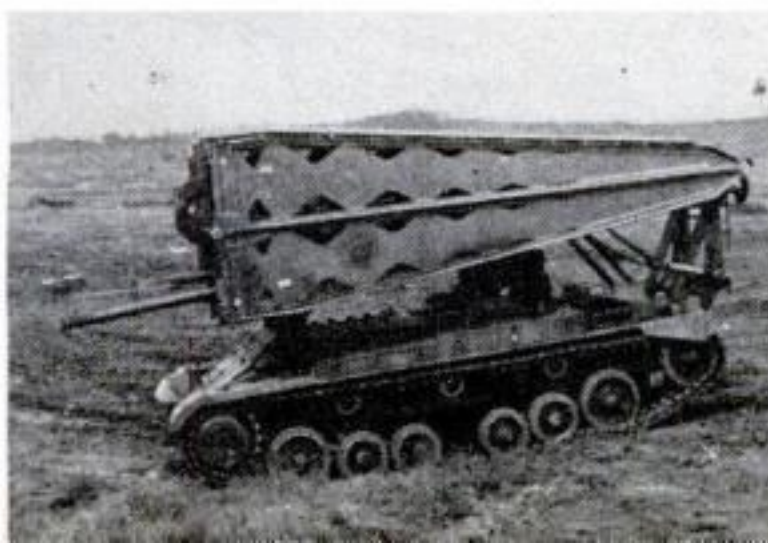
SELF-PROPELLED bridges, carried and laid by British tanks without a single man having to leave the tanks or be exposed to enemy fire, speeded the armored thrusts across France and into Germany by spanning small rivers and canals, surmounting antitank ditches and concrete emplacements, and scaling cliffs, sea walls, and other obstacles. They are now being used by British troops in Burma.

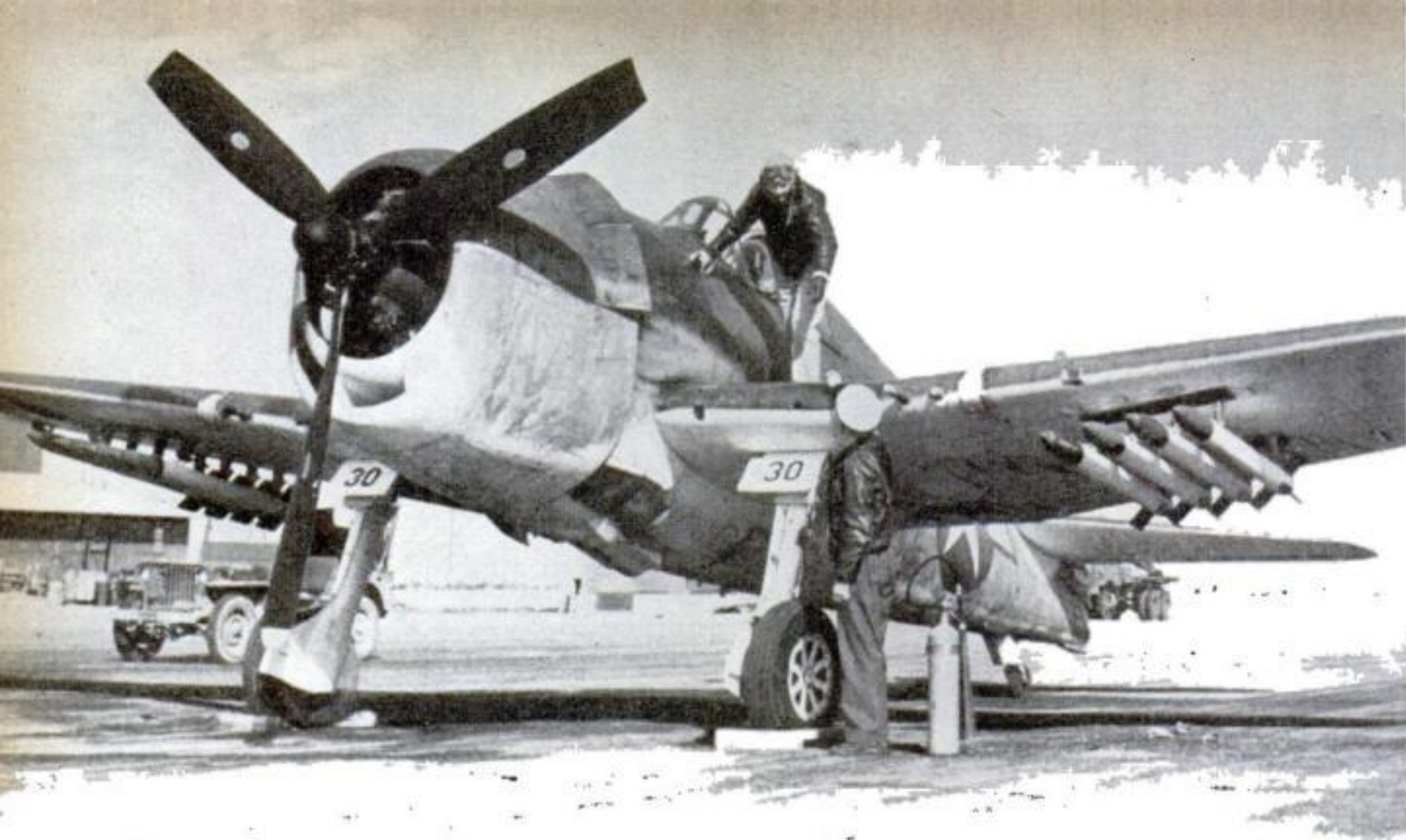
One type is the "scissors bridge," carried folded on top of a Valentine tank and automatically opened across a gap. Another is the Churchill bridgelayer, a 30-foot span

steel trackway mounted on a Churchill tank and built to carry 38 tons. This bridge is raised by a hydraulic arm and lowered across the gap in front of the tank, which then withdraws to make way for other vehicles to cross.

A third type, the Ark, consists of two trackways fixed together to form a bridge projecting in front of the tank and held there by steel wire rope. The Twaby Ark, a turretless tank with fore and aft trackways, is driven directly into a gap and extends a track to either bank, the tank itself forming the middle section of the bridge.

The scissors bridge (below) is carried folded on top of a Valentine tank, its lifting rod sticking out in front. As the tank stops before a crater, the rod, worked by hydraulic pressure, lifts the bridge clear of its supports and deposits the pointed ends on the ground. Bridge opens automatically (right) to span the gap; tank backs away.





War rockets require expert handling. Here the safety officer at the Naval Ordnance Test Station, Harvey Field, Calif., hands a safety plug to the pilot of a Grumman Hellcat, who puts it in the instrument panel.

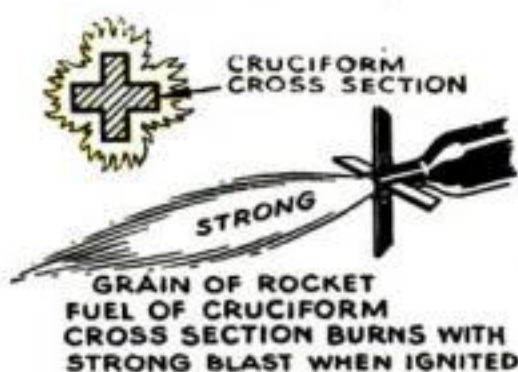
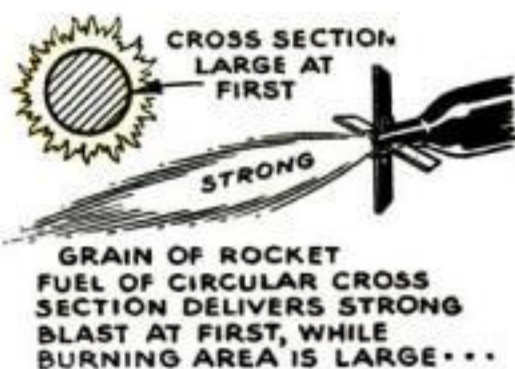
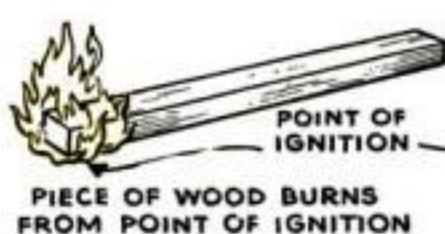
WHAT MAKES THE ROCKET GO

Just any kind of gunpowder won't do. It takes a precision-made fuel to propel these deadly projectiles with accuracy.

By VOLTA TORREY

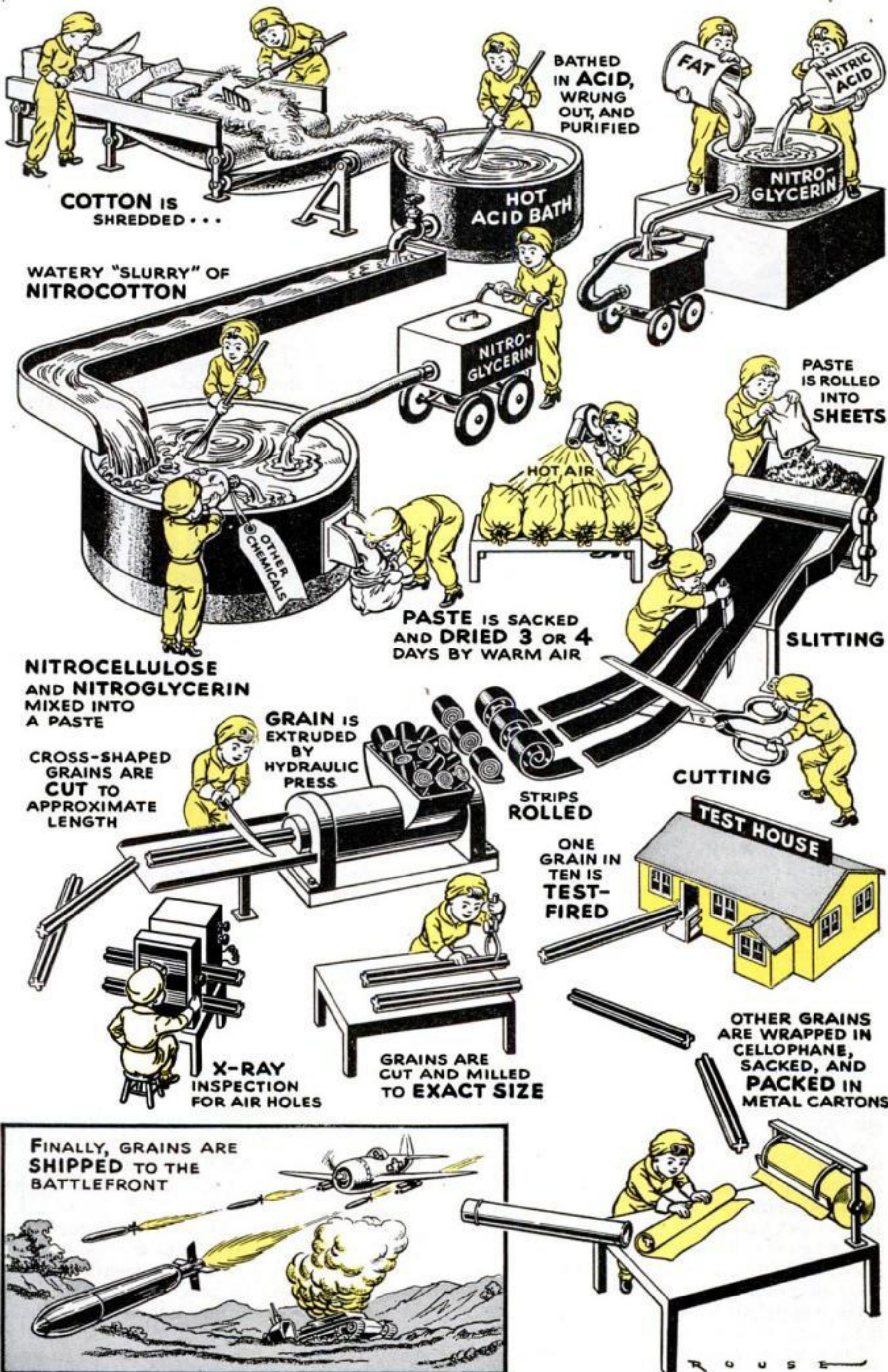
THE newest tool of war is a self-driven arrow—a long, thick, black, 12-sided rod that looks as though it were made out of hard rubber. A child or a chemist might quickly suspect that it was a secret weapon. But an ordinary fellow, seeing one of these oddly shaped clubs for the first time, has to wipe a look of incredulity off his face when told that it is a stick of concentrated zoom that already has revolutionized warfare.

These solid bars of chemical energy are the innards of rocket motors. They are made out of cotton and fat. Each one has the power, when put in a light tube and set on fire, to hurl itself and a war head into the enemy's midst by consuming itself. This method of pulverizing opposition has been so effective that America's facilities for manufacturing these flaming arrows still were being en-



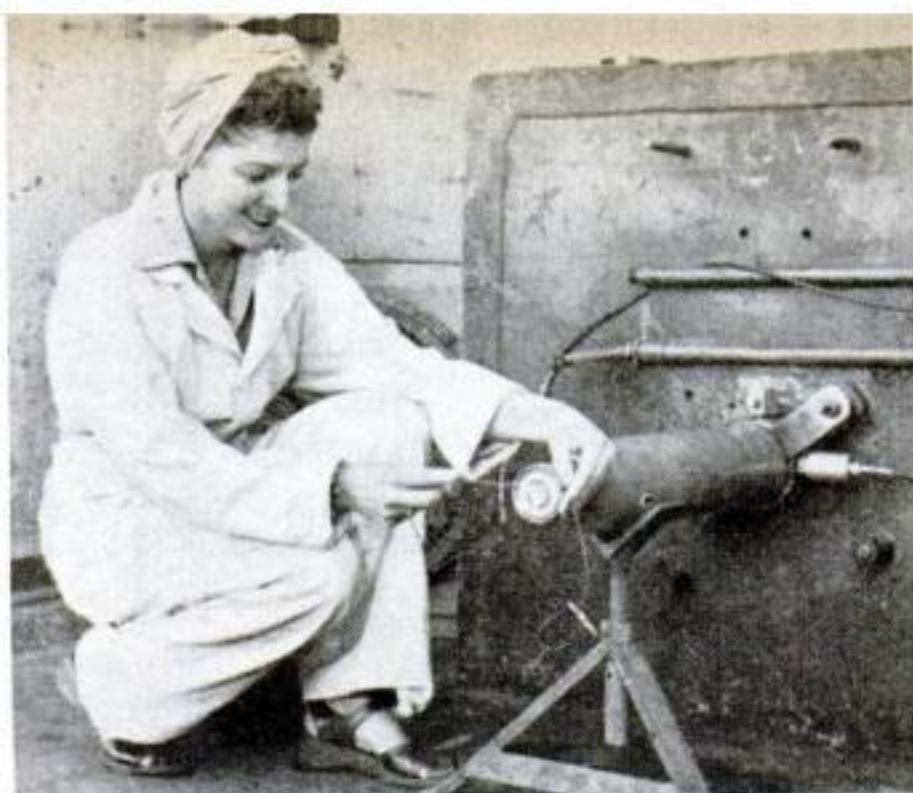
The long, rodlike grains of rocket fuel are cruciform (cross-shaped) in cross section so that they will burn at even speed.

HOW GRAINS OF ROCKET PROPELLANT ARE MADE





TESTING ROCKET FUEL at the Radford (Va.) Army Ordnance Works operated by Hercules Powder Co. The "motor" is bolted to a concrete block. A worker inserts the ball gauge that measures pressure.



Electric firing leads are connected to the base igniter. A spark will set off the igniter, which in turn will start the rocket powder burning. One out of every ten grains of fuel is tested.

larged after production of other matériel was allowed to taper off.

Until now, the story behind the nation's investment of \$1,350,000,000 in rockets this year—four times as much as in 1944—could not be rounded up and told out loud. Rockets are seven centuries old, but, until three years ago, no American company manufactured military rocket powder, and these big, black bars are so new that all information about them has been highly confidential.

Tens of thousands of men and women now are making these twentieth-century arrows in colossal plants such as the U. S. Army Ordnance Works operated by the Hercules Powder Co., at Sunflower, Kan., Radford, Va., and Badger, Wis. These war workers mix, move, squeeze, chop, and test extremely explosive and inflammable materials; 6,000 fires broke out in one month in one plant. But the work has been so surrounded by modern safeguards that fewer people were hurt in these plants last year than in any other American industry.

Technically, each big, self-driven arrow is a single grain of a double-base solventless gunpowder. The safe mass production of such gigantic grains is an industrial achievement that was made possible by know-how acquired from the British in 1942, plus the intensive research of many American ordnance men and powder chemists.

A grain of ordinary gunpowder (P.S.M., May '44, p. 128) is usually a perforated cylinder up to an inch in diameter and rarely more than two inches long. But these new rocket-powder grains are solid, shaped like a cross rather than round, four inches thick, and from three to five feet long. A five-foot grain weighs about 40 pounds and is the equivalent in weight of about 13,600,000 grains of .30 caliber rifle powder.

Double-base powders were developed half



After the shot, the hot motor and the ball gauge are removed from the block. The motor is cooled off for the next test, and the copper balls are taken out of the gauge for accurate measurement.

a century ago, but the world was slow to perceive their potentialities as rocket-pushers. These particular grains are about half nitrocellulose, which is made from cotton or wood, and about half nitroglycerin, which is made from fat such as housewives save. Both nitrocellulose and nitroglycerin are high explosives, used in making dynamite. But, with the help of other chemicals, they now are being united in such a way that a compound is made that burns instead of exploding.

The first rockets fired in this war contained solvent powder, which was considered safer to produce than solventless powder. It is still being used in many rockets, but it cannot be formed into such gigantic grains as are now being turned out. Thirty grains of solvent powder are needed to pro-



Flame shoots from the nozzle for 22 feet as the 4.5-inch rocket motor is fired. Photographing against a gridded backdrop enables test engineers to measure the tongue of fire produced by the burning powder gases. In the test chambers, temperature and humidity are controlled to simulate the conditions under which the rockets will be used. The concrete block keeps the motor from hurling itself through the air.



Precision gauging shows exactly how much each of the copper balls has been squeezed between the hammer and anvil in the test apparatus. This reveals the gas pressure.

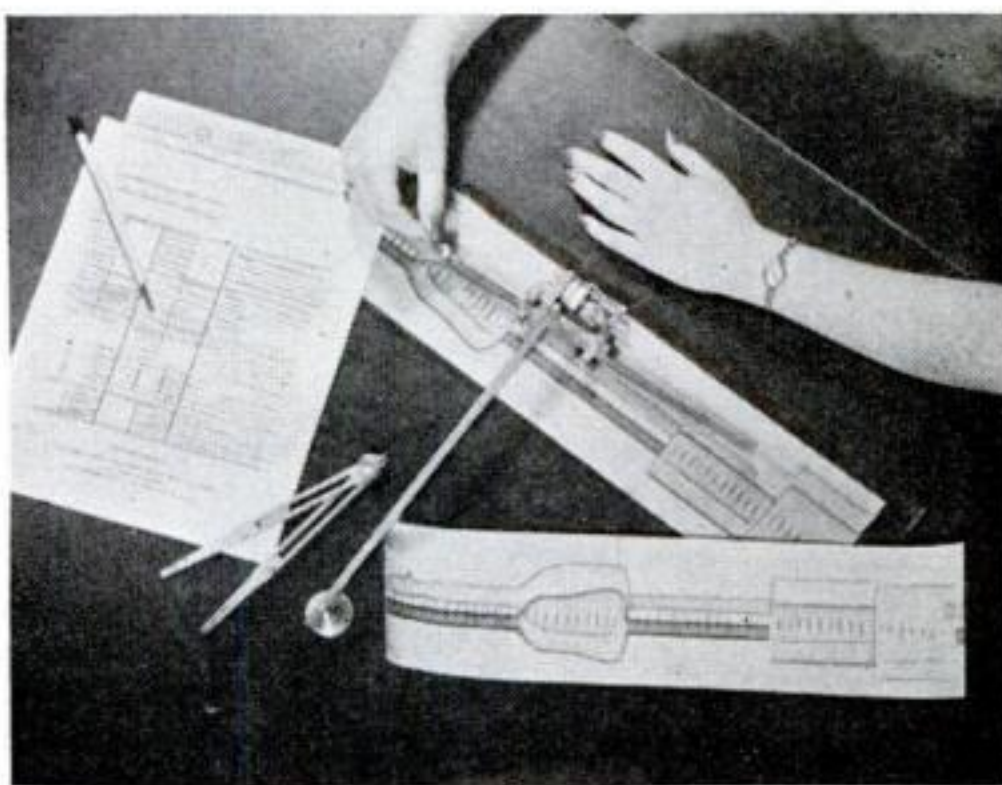


Photo charts made with a rotating-drum camera are measured with a planimeter to determine the area of the pressure time, which is used in calculating the mean pressure and, from that, the velocity of the jet from the rocket.

pel one 4.5-inch rocket, and they must be held in place by a wire framework inside the tube. With the new solventless powder, a single grain can be made big enough to fill an even bigger rocket. No wire framework is needed and the casing can be lighter. Weight is saved, and the rocket's power is increased.

With big, single, solid chunks of fuel, rockets also are being made more accurate. This accounts for the peculiar shape of the fiery arrows. A rocket is driven by the reaction to the ejection of gas from its tail. The speed and smoothness of its flight are determined by the velocity and steadiness of that jet. If the fuel does not ignite quickly, the rocket gets off to a slow start. And if the fuel burns unevenly, creating gobs of gas rather than a steady flow, the

motion given to the rocket is irregular.

These new rods of American-made propellant powder do not burn like a candle or a stick of wood, from one end to the other. Instead, when they are ignited at any point, the whole surface of the fuel begins to burn. The constancy of the combustion, consequently, is determined by the size of the burning surface.

Suppose, for a moment, that the big grains were round. The amount of burning surface then would decline as the fuel was consumed, less and less gas would be given off, and the rocket would lose speed. The grain might, of course, be hollow. The flames eating outward would then enlarge the burning surface, more gas would be created, and the jet's power would increase. But a con- (Continued on page 214)



Fleet Has Fast New Scout Seaplane in Curtiss Seahawk

TWICE as fast as the veteran Kingfisher and with three times as much power in her mighty radial engine, the new Navy SC-1 Seahawk has joined the fleet. Catapulted off a cruiser or battleship, this single-place

scout-observation float plane spots gunfire, locates enemy fleet units, and serves as a rescue plane. Folding wings (above, with beaching gear) are a new space-saving feature in Navy scout-observation planes.



Kellett Helicopter Gets Army Tryout

AT THE Kellett Aircraft Corporation plant in Upper Darby, Pa., Army Air Forces engineers have been putting the XR-8 experimental helicopter through its paces. The machine is distinguished by a novel arrangement of rotors, using two three-bladed "windmills" on separate shafts, synchronized to intermesh.

Sign Stops Motorists Where Highway and Skyway Cross

LATEST sign of the air age is this crossing warning at LaGuardia Field, New York's municipal airport. In the photo, the Grum-

man Widgeon, three-ton amphibian, is being towed tail first from a runway to its berth in a Pan American Airways hangar.





Flying Truck Carries a Ton a Mile for Seven Cents

DESIGNED for cargo use after the war, this British-built Miles Aerovan transports 12 passengers or a ton of freight over a 450-mile range at a claimed cost of about seven

cents a mile. Cruising speed is 115 m.p.h., top speed 130 m.p.h. A small automobile can be put aboard it. The makers also suggest its use as a flying camp "trailer."

Flyer Moves Freely in Pressurized "Strato-Suit"

WITH his head incased in a transparent plastic bubble and his body surrounded by air at four pounds' pressure, this flyer wears his own personal pressurized cabin. He can walk, sit, squat, and write with comfort and safety under high-altitude conditions. A single conduit, which can be disconnected with one movement, contains an oxygen hose and electrical connections for microphone, earphones, and heater wires. Airtight and watertight slide fasteners make it possible to don the suit in two minutes; in an emergency, the headpiece comes off in a second. Developed by the B. F. Goodrich Company under the direction of the Air Technical Service Command, the "Strato-Suit" has been tested in a pressure chamber for conditions equivalent to an altitude of 80,000 feet, or more than 15 miles.





Now It Can Be Told

Raw courage got vitally needed cargo barges across the stormy Atlantic for ferrying duty in the invasion. Giant tugs did the towing, as smaller ones rode herd.

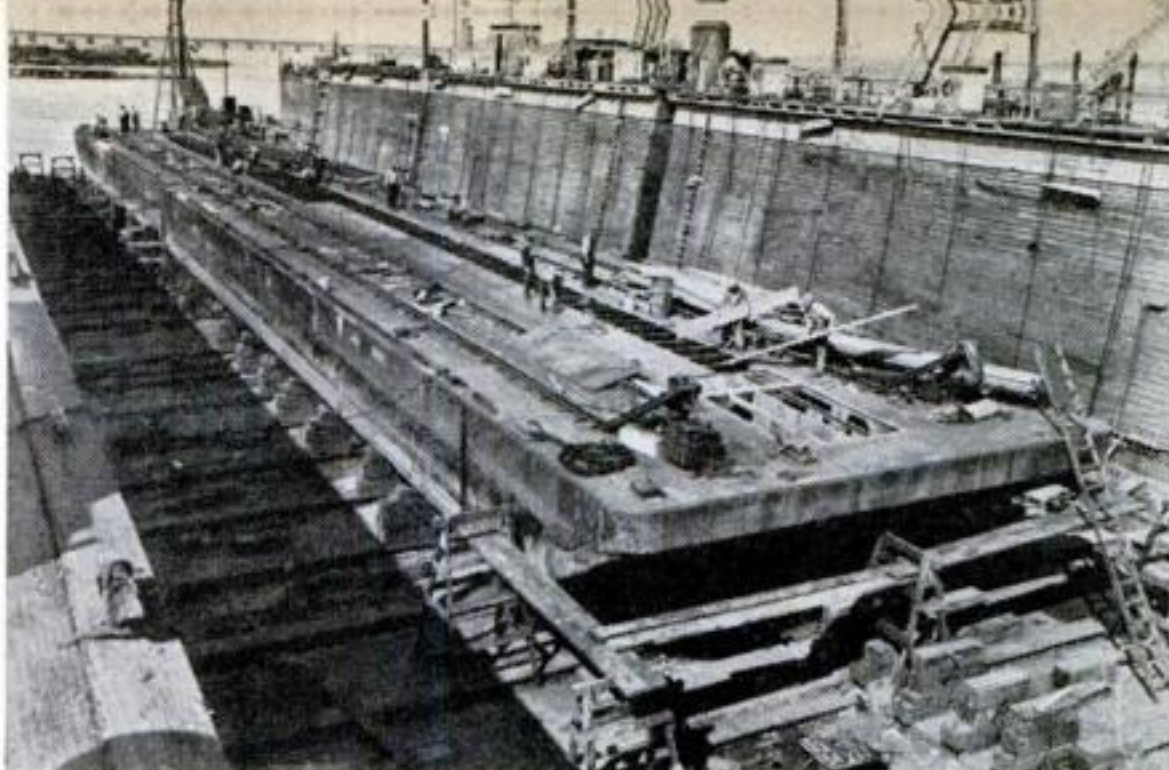
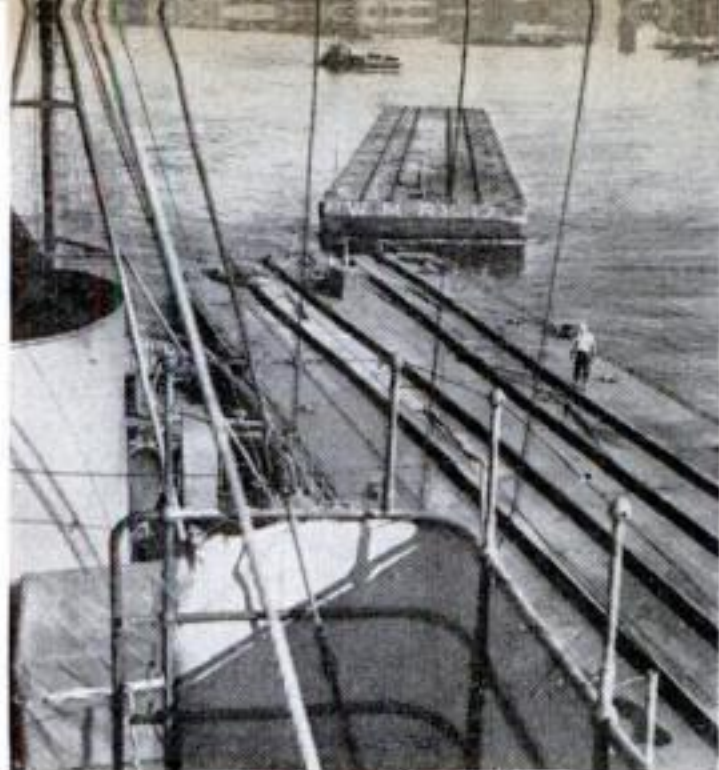
How Pickaback Barges Bucked Atlantic Gales for D-Day

Herded by tossing tugboats, clumsy craft built for quiet harbor waters braved ocean storms to join Eisenhower's invasion armada in England for the Normandy landings.

IT LOOKED like a big barge, but it rode too high above the water for a barge. From a distance, it resembled a pre-Civil War battleship, but its bow and stern were as square-cornered as its superstructure, no guns were mounted on it, and there were no signs of a crew, portholes, or engines.

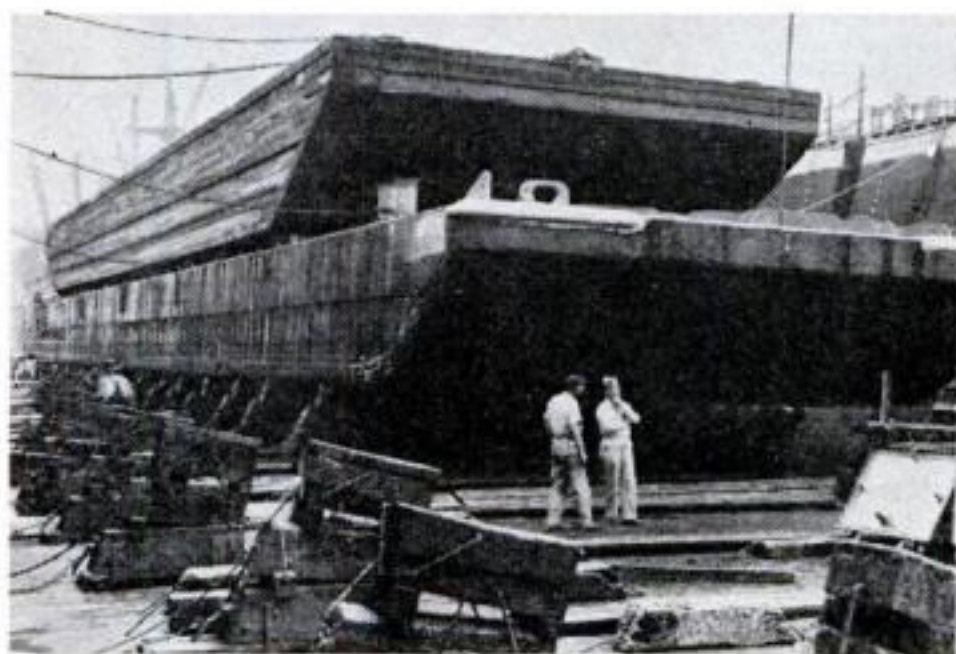
The German submarine skipper who saw one, then a long line, of these things through his periscope must have blinked. What secret weapons were these gigantic, awkward boxes, wallowing in the waves behind towboats plodding toward Europe?

Before he got a [\(Continued on page 76\)](#)

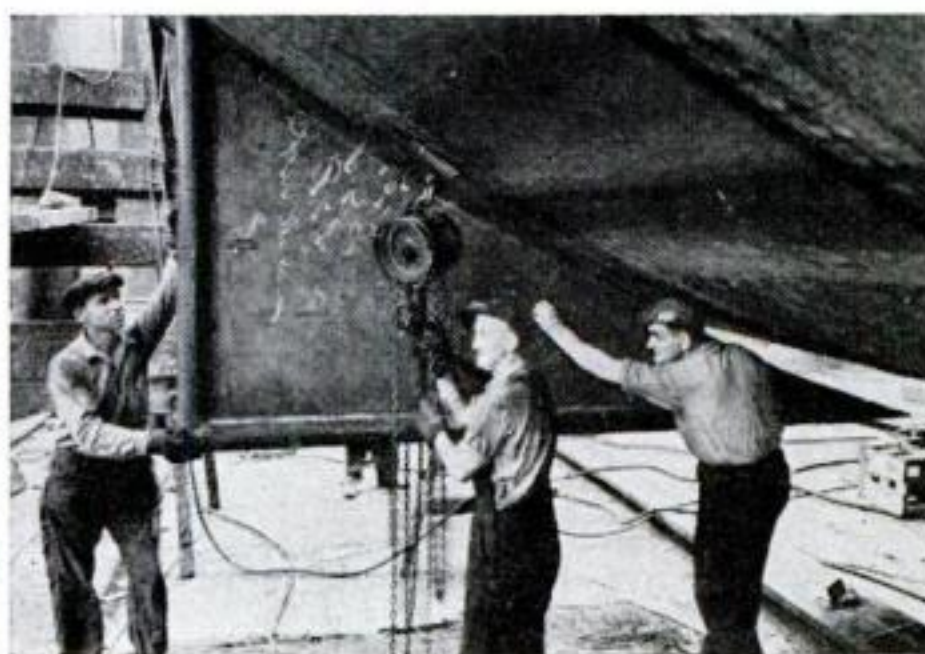


Railroad-car floats were commandeered to carry the shallow-draft barges, pickaback style. Barges were too fragile for ocean towing.

The 250-foot-long car floats had to be reconditioned in dry dock in rush time. Some had seen 25 years' service. Strengthening timbers were put in below decks, and bows were reinforced to withstand pounding of the sea. Also, concrete was poured in to give rigidity.



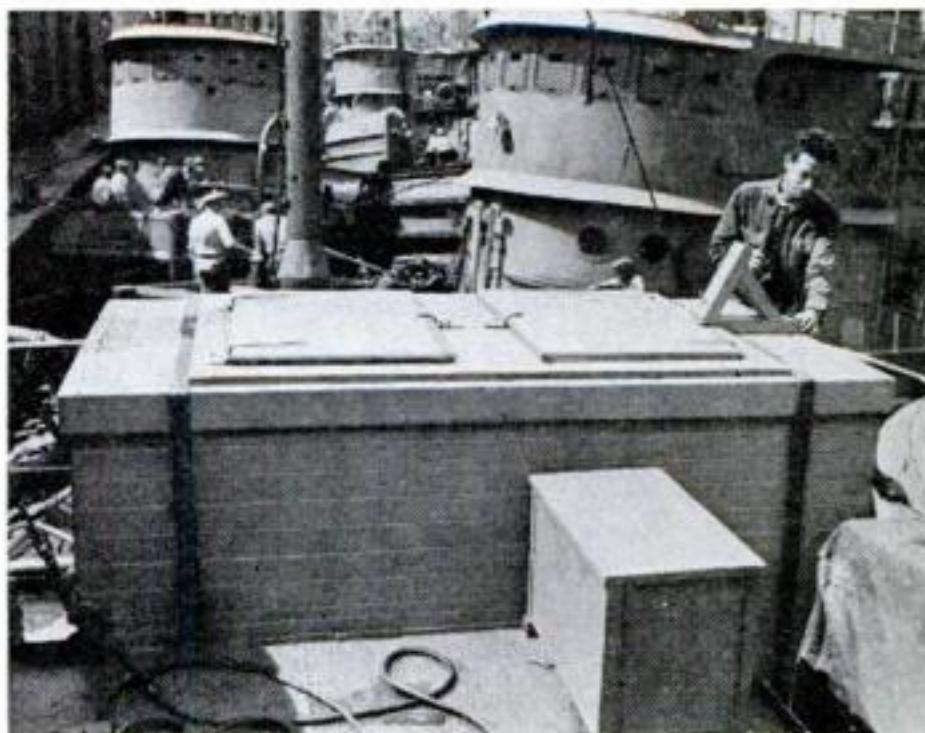
Then the float was lowered into the water and a barge nudged into place, resting on a cradle. Hoisted again, the float and barge were lashed together with steel plates and heavy chains.

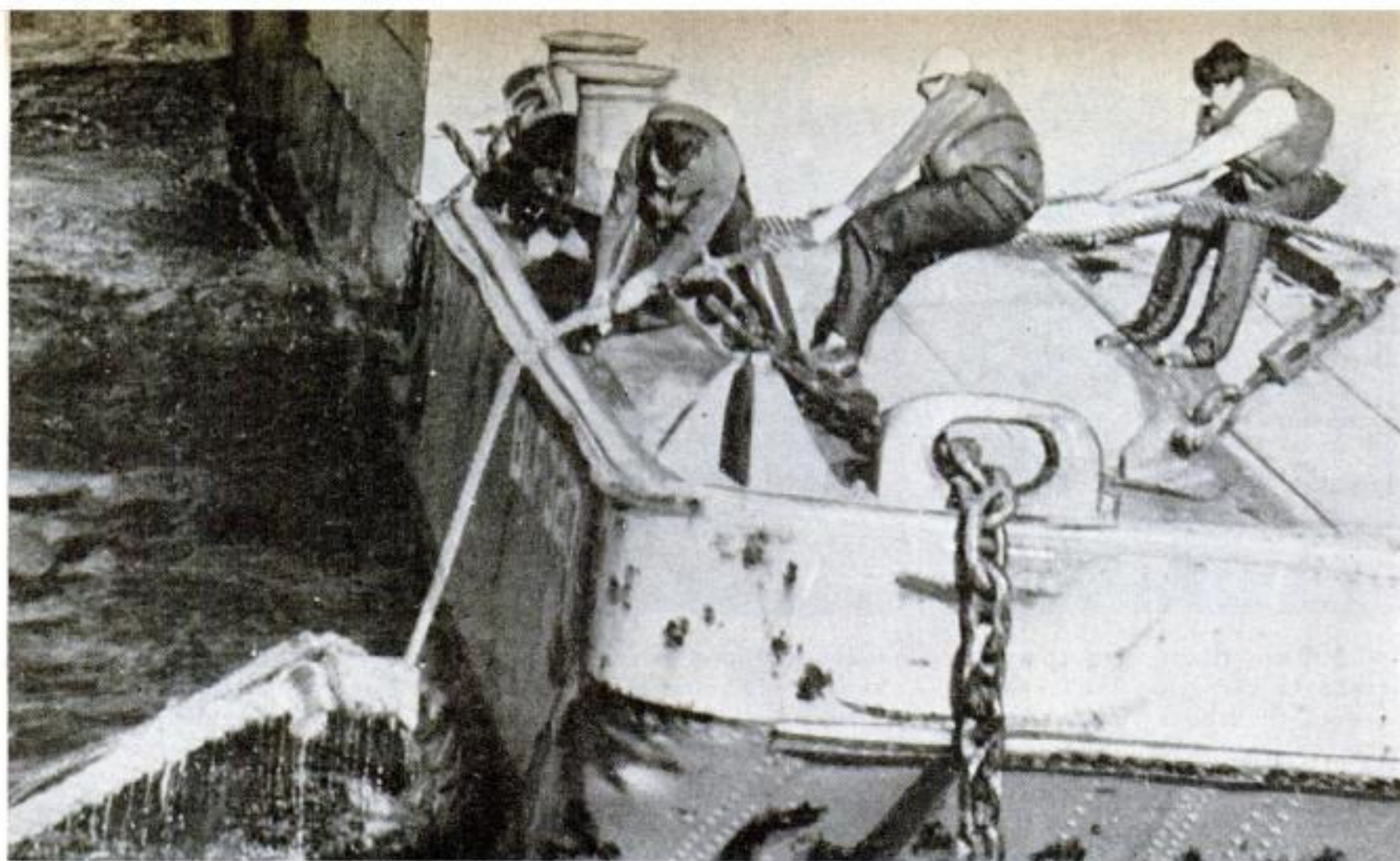


At the same time, two fabricated skegs, or rigid rudders, were welded to the smooth stern of each float to keep it from veering too much. Old manhole covers were removed and replaced with tightly fitting ones.

This is a 250-pound spider. The hawser from the tug ran through the shackle at the point of the V, and chain lines were made fast to each side of the barge from the others. Note that each shackle bolt is held in place by a lock bolt.

ST's—300-ton, 86-foot small tugs—also needed special fittings for the ocean crossing. The man in foreground is lashing a refrigerator to an aft deck. Metal plates cover pilothouse windows on tugs in background. ST's went along to corral barges that might break loose.





Gales that whipped at 97 miles an hour often snapped hawsers and iron chains of bridles, turning the clumsy floats loose on a rolling sea. These men struggle to reconnect a tug to a pickaback that broke away.

better look-see, or could aim a torpedo, he was routed by destroyer escorts. Three fleets of these strange craft were tediously convoyed across the Atlantic. Hundreds of men had helped prepare them, and one convoy bettered Columbus's best time of 37 days by only five days, but the secret was well kept.

These queer things were simply barges riding on bigger barges.

To land armor in Normandy, General Eisenhower had called for scores of harbor barges, each capable of holding a deckload of 1,000 or more tons with a draft of six

feet or less. New York's big harbor was searched in vain for a barge that would meet the requirements. Those that could be carried overseas on the decks of freighters were too small, and the bigger barges had not been built to withstand the rigors of an ocean trip.

But tugboats were shoving a solution to the problem under the very noses of the worried officers all the while. You, too, have probably seen those long, steel, car floats on which strings of freight cars are moved across rivers and harbors. Those flat-top ferries could be strengthened, and other barges could be placed on top of them.

This float is adrift and listing, as repairmen in a rubber boat approach to board it. No one rode the pitching pickabacks. In one convoy 10 of 14 float-toting barges broke up and had to be sunk.



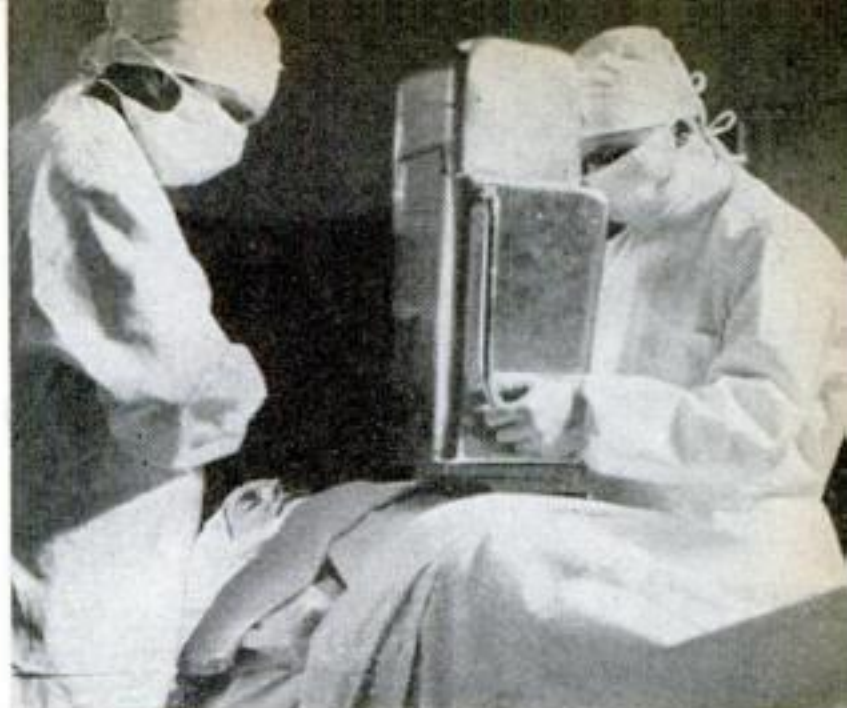
In England, these pickabacks could be parted again, and both parts could be used as barges to land weapons in France.

Stacking barges up this way, of course, would be as unusual a stunt as perching coupes on top of sedans for a transcontinental automobile race. But the Army Transportation Corps, headed by Maj. Gen. Charles P. Gross, tackled the job, and old floats and barges were hurriedly assembled from all along the eastern coast by Maj. Gen. Homer M. Groninger at the New York Port of Embarkation.

The railroad ferries were simply shallow, compart-
(Continued on page 226)

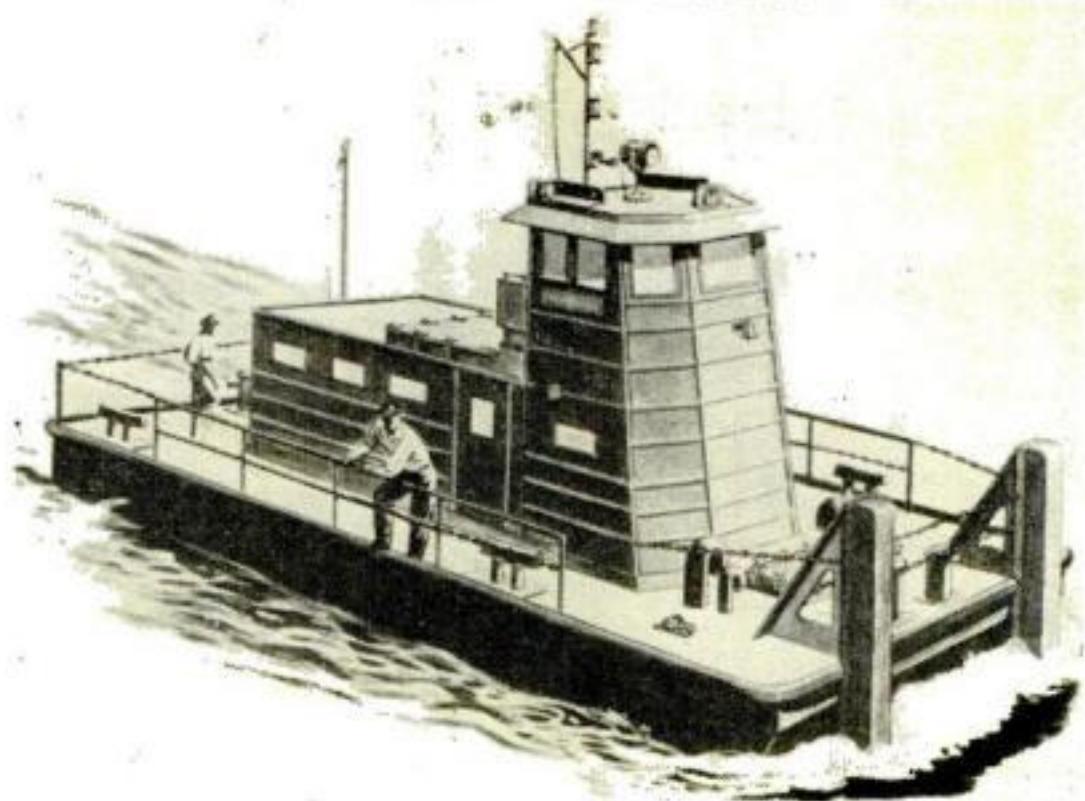
This Sterile Camera Takes Pictures of Surgical Operations in Color

FOR recording operating techniques in hospitals, a specially designed camera called the Surgiscope has been developed. The camera is held inside a housing that is subject to the same sterilization as surgical instruments. It weighs 12 pounds, and is equipped with flash bulbs for eight pictures.



War-Tested Sea Mule Will Be Peacetime Tug

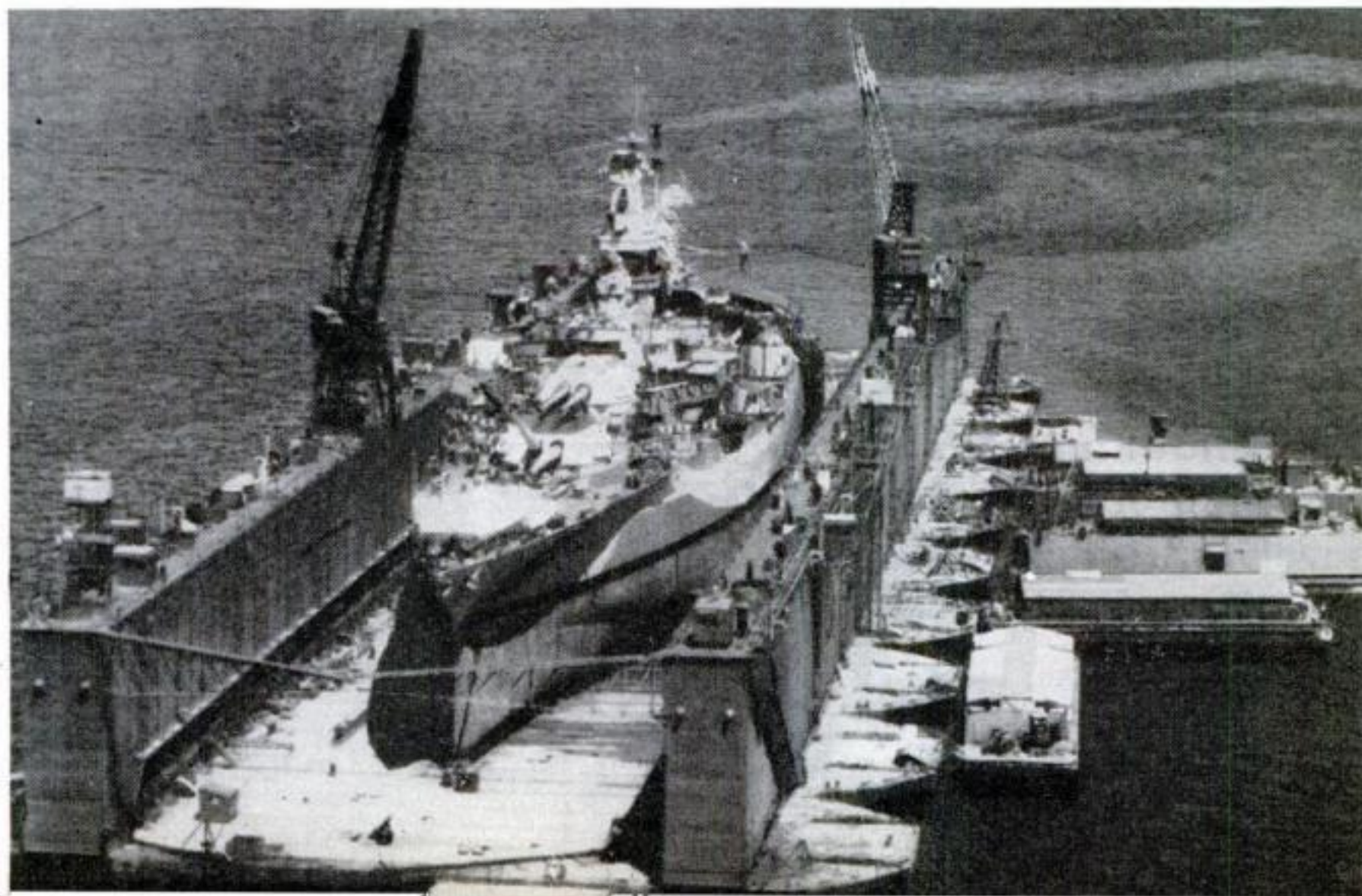
THE all-welded steel tugboat known as the Ingalls Sea Mule, which is said to have more power per square foot than any other marine tug ever built, is slated for postwar activity on inland waterways. Its dimensions are 42 by 16 feet, and there are five types of propulsion—Diesel or gasoline—ranging from 164 to 660 horsepower. Both deep and shallow-draft models will be available, some equipped with quarters for the crew.

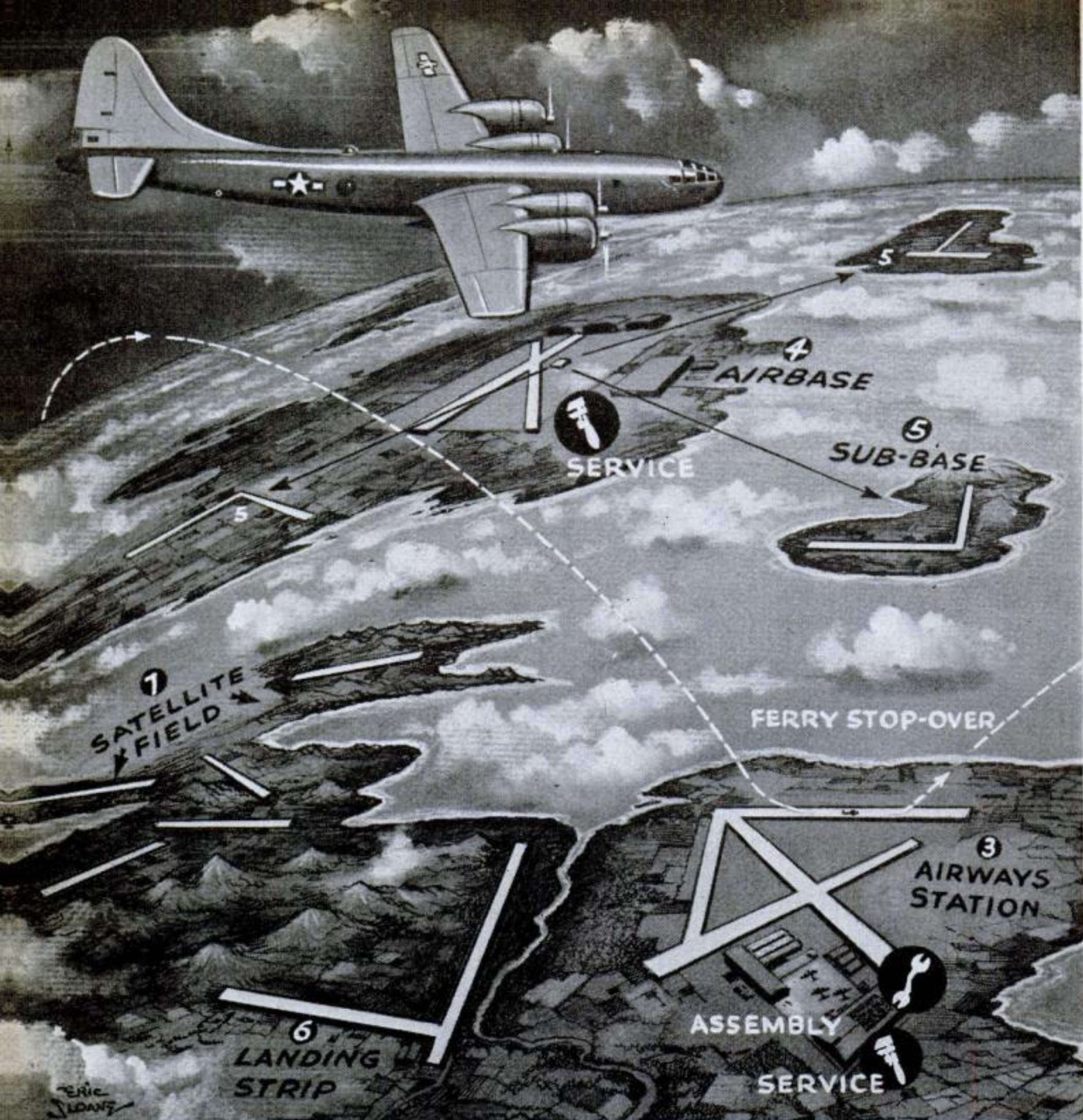


Ten-Section Floating Dry Dock Holds a Battleship

SO BIG it will hold a battleship, this floating dry dock is ready to handle the largest jobs far away from home. It is

built in 10 sections, which can be towed to any captured base and assembled for use in keeping our ships in the fight.





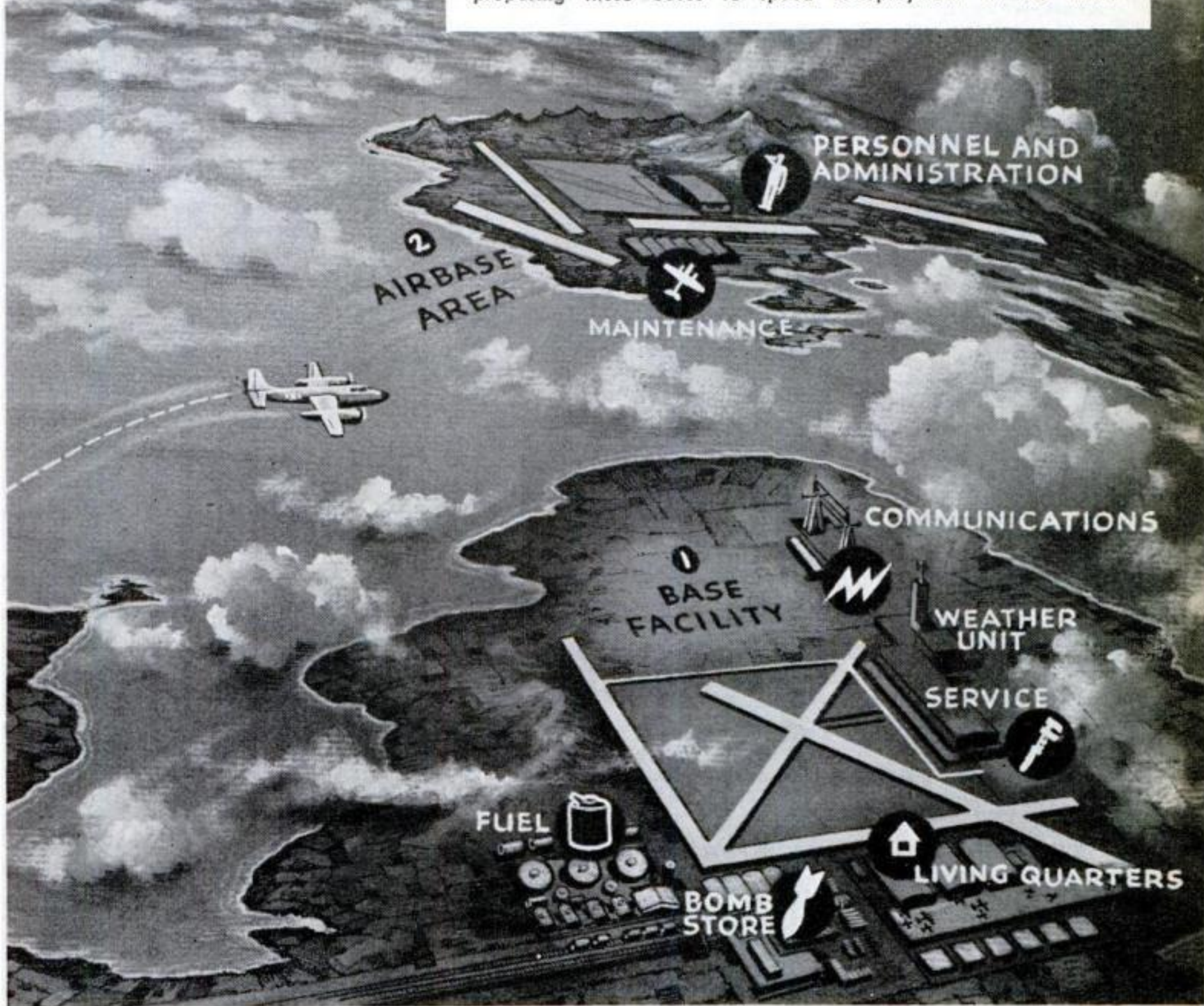
When the AAF Throws

Transplanting our airpower from Europe to the Pacific involves a mammoth job of building bases and fields.

By JAMES L. H. PECK

FOR the big job of moving our airpower from Europe to the Pacific, an AAF engineering officer said, "We've got to have the land. Then the bases have to be laid out and carved out. On these airdromes and back of them, we have to set up depots of various sizes. Next comes the equipment for the service units, and the stockpiles of matériel and housekeeping items. Fuel comes in.

SEVEN KINDS OF AIR INSTALLATIONS must be built in the Pacific areas to accommodate AAF units swarming halfway around the world to turn their guns and bombs against the Japs. In the order in which they will be used, they are: (1) base facilities, (2) airbase areas, (3) airways stations, (4) airbases, (5) sub-bases, (6) landing strips, and (7) satellite fields. Even before V-E Day, engineers and technicians were at work preparing these bases to speed redeployment of the AAF.



Everything at Japan

Then, and only then, are we ready to bring in the planes."

It is a transplanting operation of global proportions that involves every type of conveyance that moves on land, on sea, and in the air. And in carrying out this "bulk redeployment" of the AAF we had to start from scratch. We have not the land, the facilities, or the supplies on the scene, such

as were available in England under reverse lend-lease; and, with the exception of China, there is no ally in the Pacific from which we can draw on local civilian help. Every single pick and shovel, screwdriver, gasoline drum, and box of rations must be sent from either Europe or the U. S. Either way, it is nearly halfway around the world.

The planning for this tremendous task

began in Washington almost a year before the Germans surrendered. Commencing in the offices of the Joint Chiefs of Staff, the Army-Navy Logistics Board, and Gen. "Hap" Arnold of the AAF, these plans coursed through channels all the way down to Joe Doaks and Mary Smith, who sort rivets in some two-by-four plant of a subcontractor in the alley back of Main Street.

The elaborate plan calls for the moving of everything but the bases. Even the Army and Navy cannot bulk-redeploy airdromes, and these must be prepared and equipped in order that the redeployed AAF will have somewhere to go when it arrives in the Pacific.

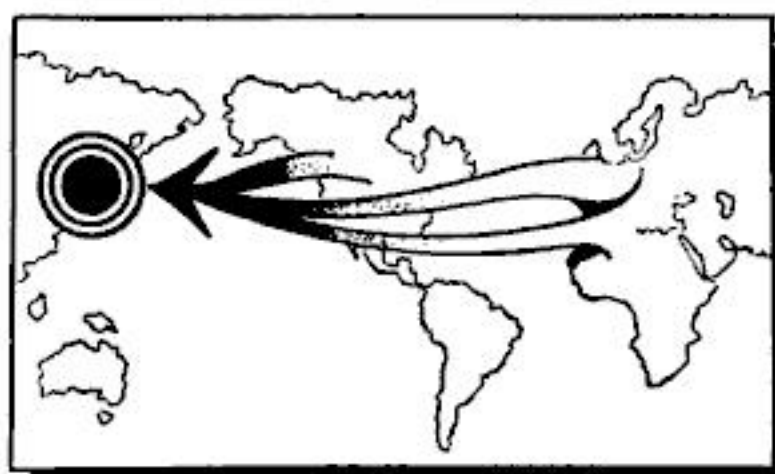
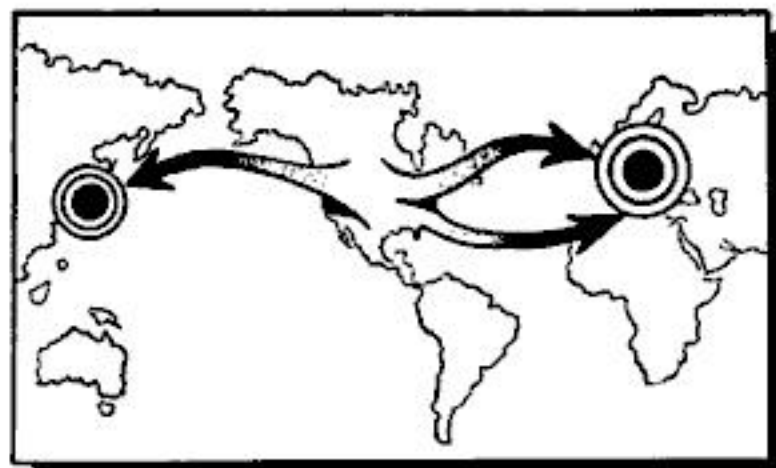
That is why the redeployment of aviation engineers, technicians, and some air units was under way when V-E Day arrived. The tactical demands of the Pacific areas make it necessary for these engineers—who will be aided by Navy Seabees—to lay out, build, and equip seven different kinds of air installations. These are described in the order in which they will be used to make possible the redeployment:

Largest are "base facilities" that include service units, four-echelon depots, underground storage for fuel and bombs and other ammunition, weather and communications units, and living quarters. They will take on the aspect of regular staging areas.

"Airbase areas" will include a number of landing strips or dispersal areas, and on these will be located personnel and facilities for administration, maintenance, supply, and salvage.

"Airways stations" will be large airdromes with complete servicing facilities, which will be used, primarily, as stopover points for ferried planes. Some of these may be used for the assembly of processed planes that have been shipped.

"Airbases" are somewhat smaller and are equipped with sub-depot or service squadron shops. The commanding officers of these



CHANGE OF DIRECTION. Until victory in Europe was assured, planes, men, and matériel flowed two ways from the U. S.—to the Pacific on one side and to Europe on the other. Now, from both Europe and America, the whole power of the AAF is aimed at a single target, Tokyo.

may also have under their control alternate "sub-bases."

"Landing strips" are located in forward areas for purely tactical operations. Several of these, widely dispersed, constitute a "satellite field."

The redeployed engineers who are building these, or enlarging existing facilities, all over the Pacific area carried with them only the most essential equipment. Everything that they required was sent direct from the U. S. and cleverly scheduled and routed so as to reach the respective points at the same time as the men from the ETO and Mediterranean.

This "marrying" of men and matériel is the most intricate single phase of our redeployment scheme.

For example, the flow of matériel to Europe was so strong that we began last October to close the valve of this pipe line. In anticipation of the surrender of the Nazis and the possibility of having to reroute the shipments of aircraft and other weapons to the Pacific, a coding scheme was employed to govern ship movements and loadings. Some vessels were marked "STO," meaning that they were to be stopped enroute in the event of the war's end in Europe. Others were labeled "SHP" to indicate that they would carry cargo that would be needed in any event. But many of these carried planes and parts. The other cargo was unloaded, but the planes were shipped back to the U. S. or routed through the Mediterranean to the Pacific. (When V-E Day arrived, 89 ships were halted at sea or recalled from foreign ports without discharging cargo.)

If it seems incongruous that swiftly moving airpower must be anchored to the slow-moving convoys, this is so because of the great variety of things needed to keep an air unit in operation. Some of these items cannot be transported by air in sufficient quantities.

President Truman revealed recently that 20 bombardment (Continued on page 194)

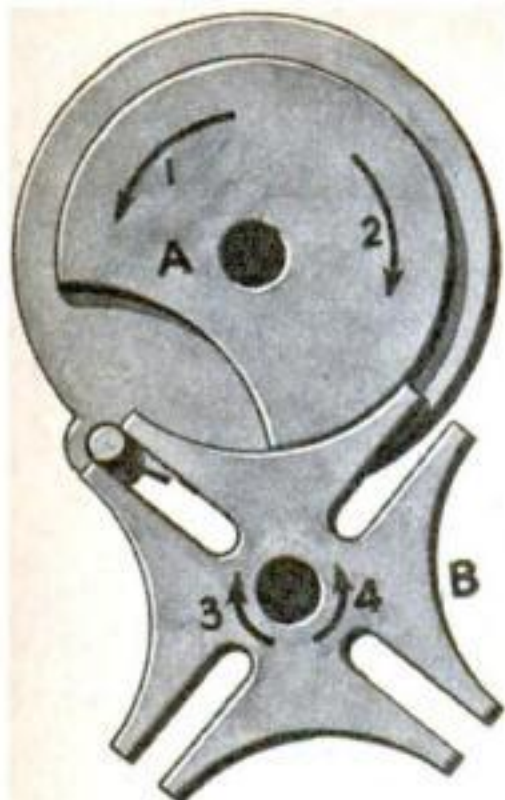
*Your
Pin Up—*

XP-55 CURTISS ASCENDER

EVERYTHING seems to be turned around in this experimental fighter. Wings, power plant, and propeller are mounted to the rear of the pilot; elevators are on the nose, rudders and vertical stabilizers on the wings. Engine is a 1,275-hp. Allison.



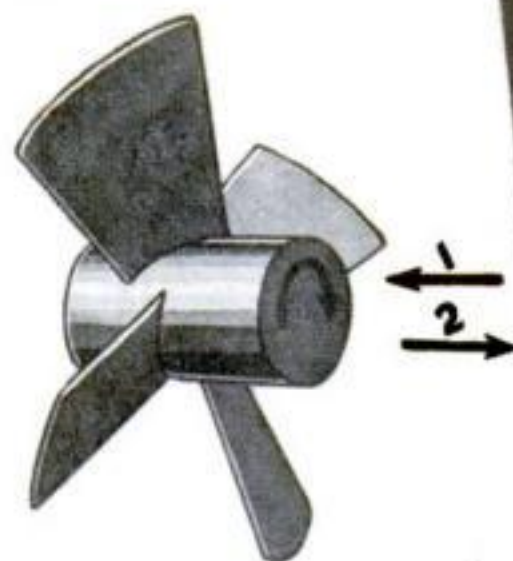
How's Your Sense of Mechanics?



- I**
- 1 Which of these rotators moves only part of the time?
 - 2 Which part of the combination is the driver?
 - 3 Will this mechanism work when A moves in direction 1?
 - 4 Will it work when A moves in direction 2?
 - 5 If B moves in direction 4, which way does A move?
 - 6 How many times does A rotate while B revolves once?



- II**
- 1 If the worm B turns in the direction shown, which way will the cogwheel A turn?
 - 2 Is it possible for the wheel A to be the driver?
 - 3 Suppose the worm were taken off, the ends reversed, and the worm replaced on the same shaft. Then in which direction would the wheel A turn?



- III**
- 1 If this four-bladed fan is turning in the direction shown by arrow, which way does it blow the air?
 - 2 If the fan, turning in the same direction, were mounted as a boat propeller, which way would the boat move?
 - 3 An airplane propeller, with similarly pitched blades turning clockwise, would move the plane in which direction?

There Are Two Sides to This!

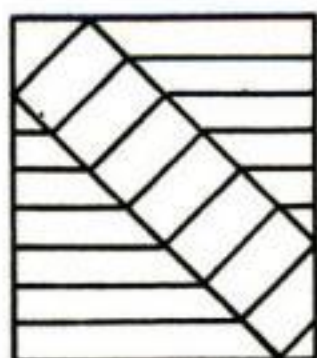
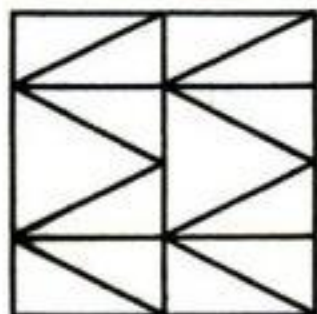
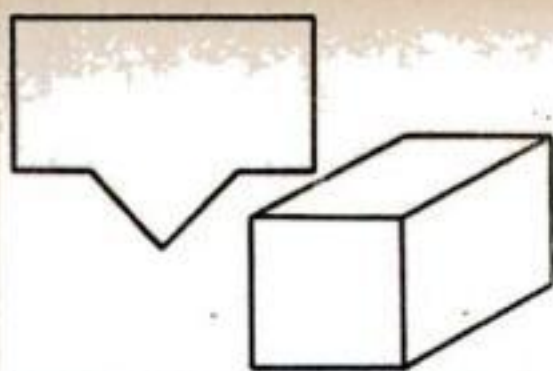
IV Conclusion jumpers had better avoid this. Get the idea carefully; note the first flag in each row. Then in the same row check the others that show the same side of the flag. This is simple if you take it easy and look before you leap to a conclusion.

How Well Do You Visualize?

HERE are ways to test your ability to understand mechanical motions, to discern the ins and outs of specially planned mental booby traps, and to pick up the meaning of mere impressions. Read the questions carefully, and take your time; the answers may not be as hard as you think. From an article by L. L. Thurstone in *Hygeia*. Answers are given on page 190.

Courtesy of HYGEIA

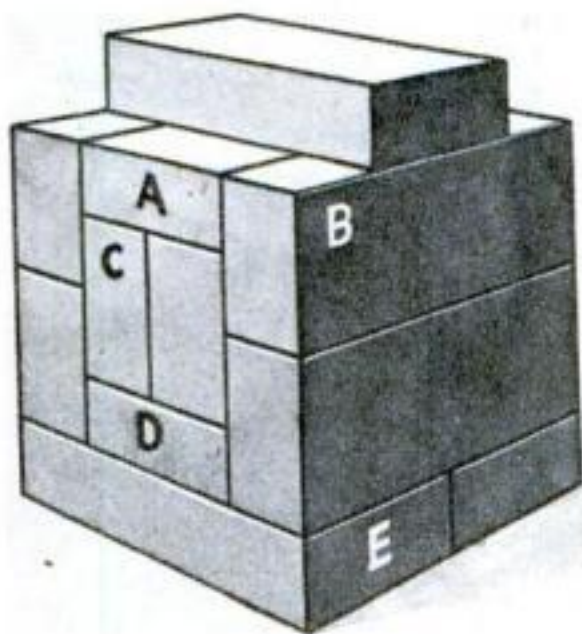
POPULAR SCIENCE



Do You See Through Camouflage?

V Camouflage is meant to be confusing. All right, one of the two figures at upper left is contained in each of the succeeding drawings. Mark only one of the figures in each of the drawings that follow them. It can be done.

This Is a Touching One!



VI Here is another for the brain as well as the seeing eye. See if you can indicate how many of the blocks touch each one of the blocks that are marked A, B, C, D, and E in the drawing above.

Does Impressionism Bother You?

VII Can you get the drift when the artist puts in only a few well-chosen lines? Figure out what the pictures at the right represent.



Can You Read the Words?

VIII How many of the 22 words—incomplete, we'll grant you—can you piece out and recognize?

bread

artist

vision

riches

sweater

visionary

riches

visionary

riches

visionary

riches

visionary

riches

visionary

riches

visionary

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visionary

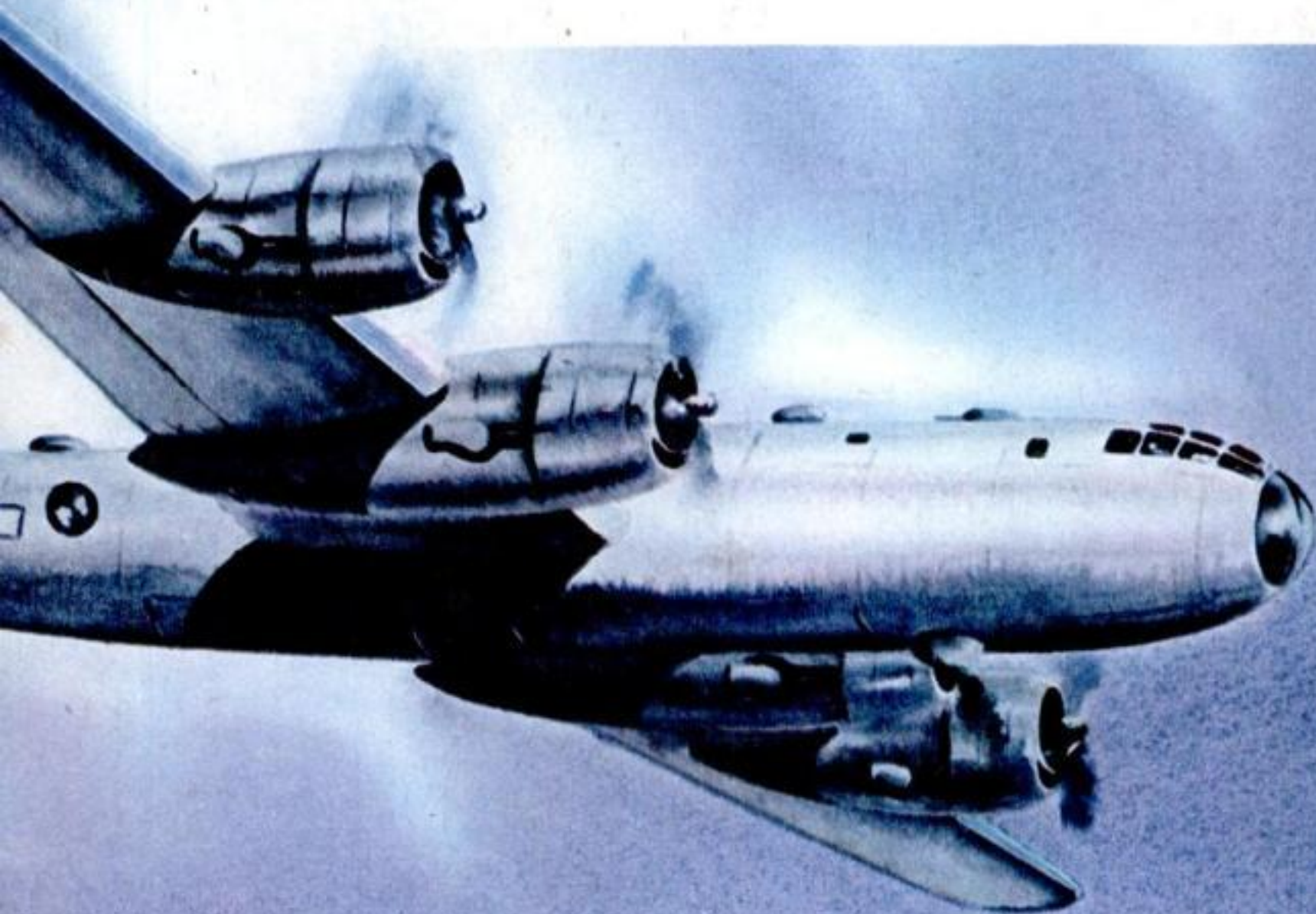


Rarely is a magazine privileged to present so dramatic and significant an article as AIR WAR: A PICTORIAL HISTORY OF THE ARMY AIR FORCES. On the following pages is recounted in brief one of military history's greatest achievements — the evolution of the United States Army Air Forces from a primitive beginning to what is probably the most tremendous striking force in the world today — a force which has shaped the history of the world and has written in the sky the destiny of millions... For exclusive permission to reproduce this material POPULAR SCIENCE is indebted to the Historical Division, Assistant Chief of Air Staff, Intelligence, USAAF. It is from the first official pictorial history of the Army Air Forces, a great book of the same title soon to be published by Duell, Sloan and Pearce, Inc., New York City.

The Editors

AIR WAR

A PICTORIAL HISTORY OF THE ARMY AIR FORCES



In less than 40 years, American military aviation has advanced from the first flimsy, kitelike airplane to such superb weapons as the B-29 Superfortress, which carries the destructive power of artillery 1,500 miles from its base.

IN AMERICA was born the first successful powered airplane, a brittle, kitelike contrivance that could be flown only under the most benign weather conditions. Less than 40 years later it introduced into warfare two factors new to the annals of military operations: major campaigns waged in a third dimension, and the envelopment of hundreds of millions of civilians in the tide of combat.

It was with sardonic humor that British

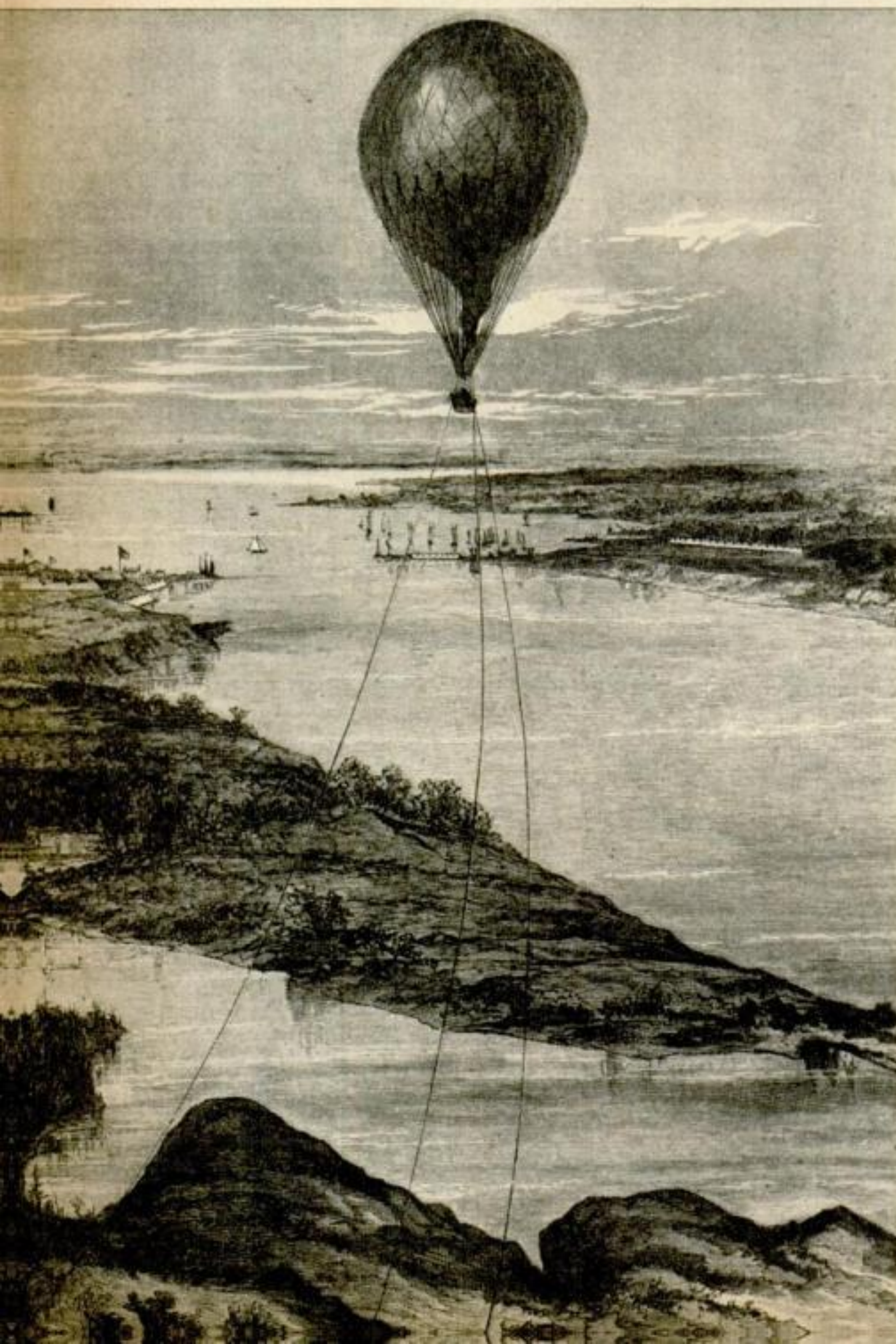
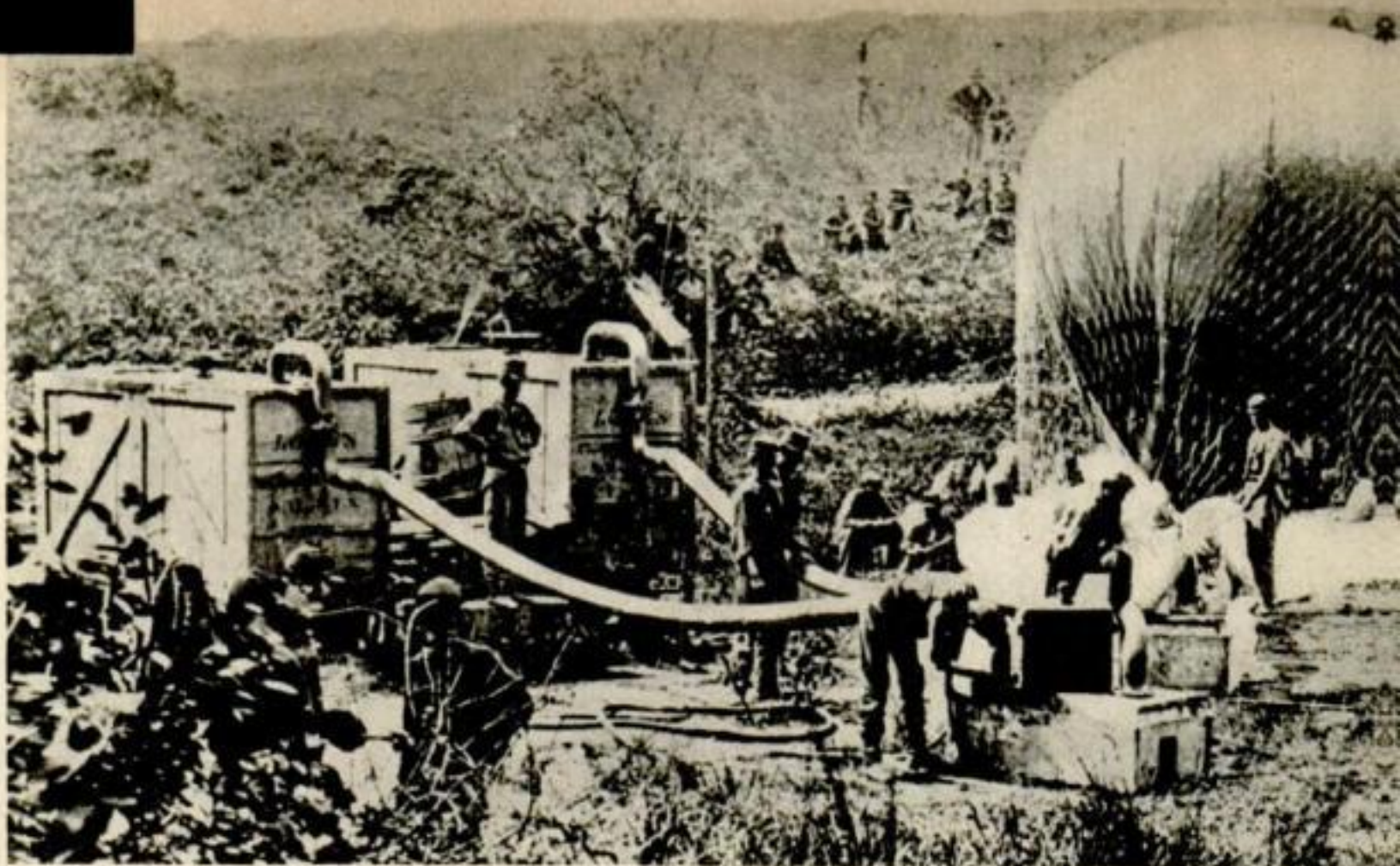
civilians said to soldiers off to the front lines of battle, "Coward!" For the war front was in London. It was in Berlin, Tokyo, Rotterdam, Vienna, Rome, and Manila. The war front was everywhere. Airpower had put it there.

The evolution of American airpower, as it is reflected in the growth of Army aviation, is associated intimately with the development of heavy bombardment aircraft, fat-bellied with bombs. The Superfortress

AIR WAR (continued) CIVIL WAR

Our Army first took to the air with the use of balloons in the Civil War. Hydrogen gas generated by pouring sulphuric acid on iron filings was piped into bags as at the right.

Ascending as high as 3,500 feet, balloons carried observers to spy on enemy troops. A coal barge used in such operations was the first aircraft carrier. Ice and wind were worst hazards.



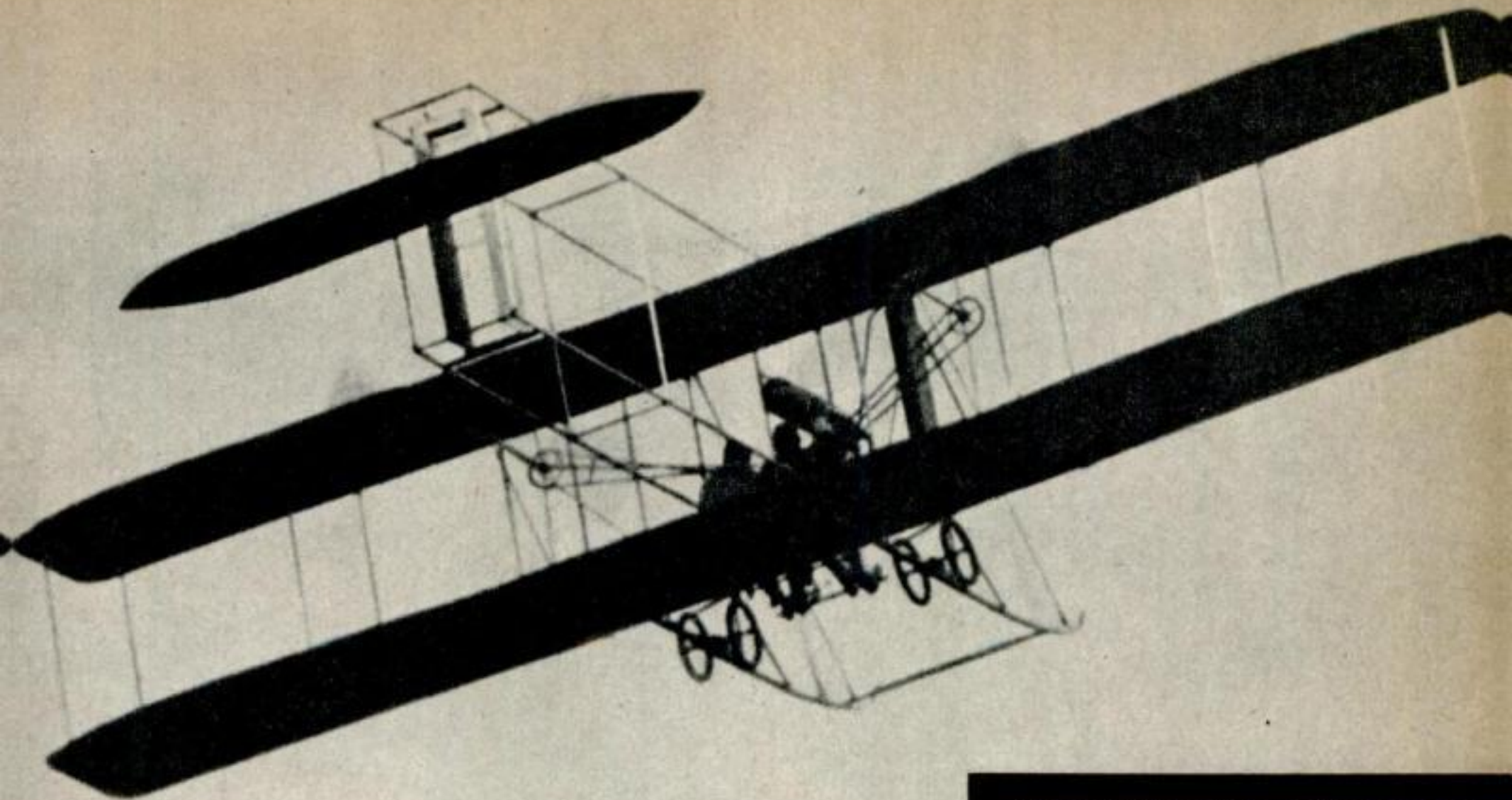
is a gun platform. Her bombs are artillery shells that can be projected 1,500 miles to help achieve the purpose of all warfare—breaking the enemy's will to resist.

Concurrent with the development of the heavy bomber has been that of lighter bombardment units—the medium bomber and the dive bomber—and the fighter plane, roving the skies to shepherd the bombers as destroyers rove the seas to protect the aircraft carrier and the battleship.

The compression of time between the flight of the first powered airplane and the initial salvo of Superfortress bombs on Tokyo is one of the greatest feats of engineering in the history of man. It was almost 600 years from the longbowmen of Crécy to the artillery barrages of World War I. It was a brief 41 years from that first 120-foot flight of the Wright Brothers at Kitty Hawk, N. C., to the 3,000-mile round-trip flights of the Superfortresses to Tokyo from the Marianas.

The history of the AAF

POPULAR SCIENCE



THE WRIGHT BROTHERS

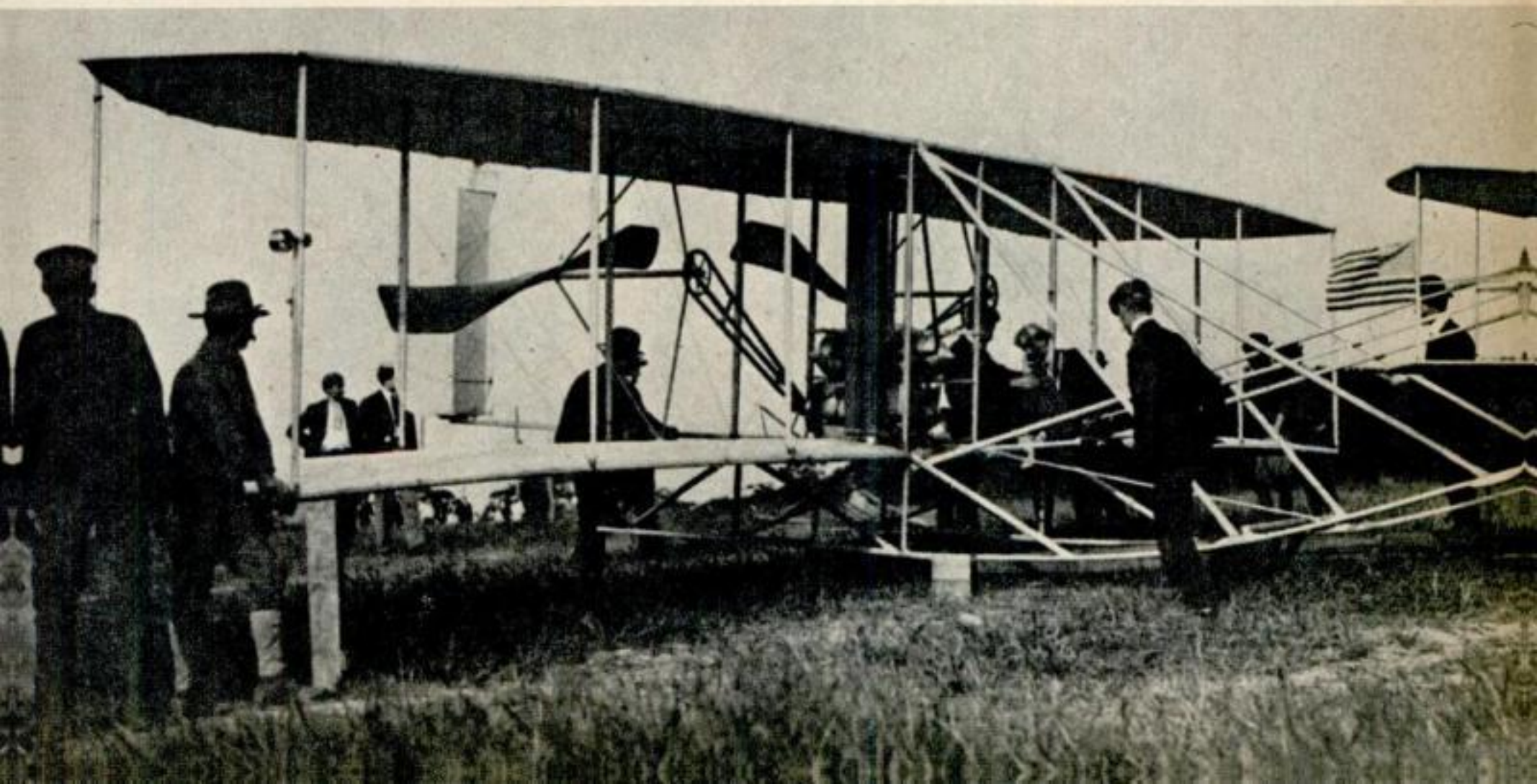
Model "B," second airplane accepted by the Army, in flight over College Park, Md. One of the pilots is Lt. Henry H. Arnold, now five-star general of the Air Forces. This plane had a wing span of 39 feet (compared with 141 $\frac{1}{4}$ feet for the B-29 Superfortress) and was powered by a four-cylinder, 30-hp. engine.

really starts not with the year 1909 and the delivery of the Army's first plane, but with the Civil War. The first "air force" was a covey of balloons. From balloon perches, Union observers counted the Confederates' tent lights at night and so estimated their strength. Union balloonists "spotted" artillery fire. Newspapers and magazines wrote glowingly of the "sailings" of these

"generals of the skies." Military ballooning drew the first "antiaircraft" fire. From it came the first "bombproof shelters"—dug-outs protected by sandbags to permit balloon crews to escape the missiles directed at the gas bags.

The Army's interest in heavier-than-air flight was shown in 1898 and 1899, when the War Department subsidized Samuel

Heavier-than-air military flying began when the Wright "Flyer" (below) surpassed the Army's drastic requirement of a speed of 40 miles an hour. This, our first Army plane, was launched from a track and landed on skids. It was delivered in 1909. Two years later, the Signal Corps had a force of five planes.

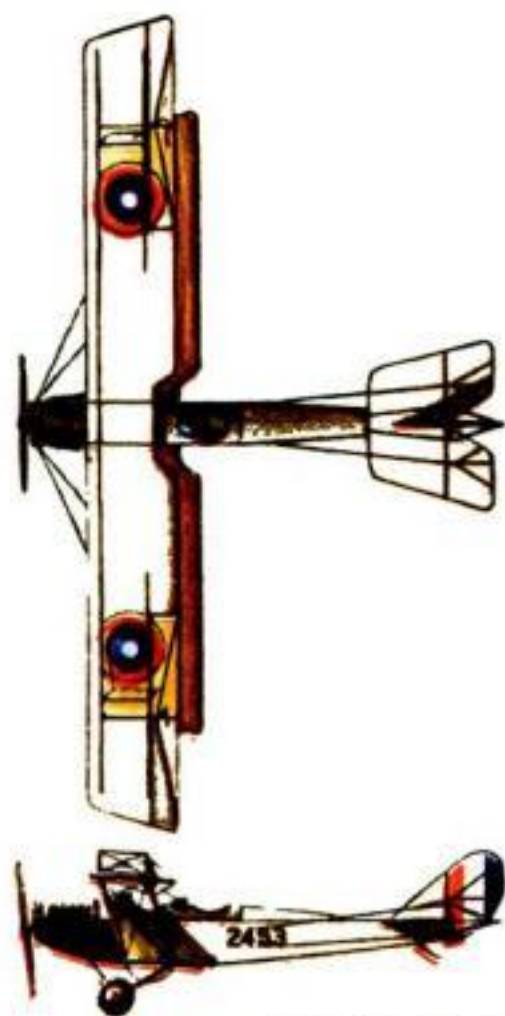


Pierpont Langley with \$50,000 to do experimental work on an airplane. After several years of effort, in the course of which Charles M. Manly developed the forerunner of today's radial aircraft engines, Langley failed to fly. Less than two weeks later, on December 17, 1903, Orville and Wilbur Wright did fly.

The Army accepted its first heavier-than-air flying machine in 1909. The specifications called for a speed of 40 miles an hour. The Wrights exceeded that by 2½ miles. In 1911 Army aviation, under the Signal Corps, consisted of five planes, three built by the Wrights and two by that other hardy pioneer, Glenn Curtiss. In 1912 the rating of Military Aviator was established, and in that same year a youngster named Henry H. Arnold set an altitude record of 6,540 feet and won the first Mackay Trophy for a speed of 43 miles an hour over a 30-mile course.

Before war swept Europe in 1914, the Army's two dozen pilots knew they had their hands on a new weapon. They tested a bombsight. In newspaper interviews they pictured a misty future in which whole battles would be fought in the air. Their imaginations were a bit ahead of the designers. Of eight planes sent to Mexico with

Dogfight: Eddie Rickenbacker, flying a French-built Spad, trains his two Vickers machine guns on a fleeing Fokker D-7. Below are three famous Allied planes and, at far right, the twin-engine Martin MB-2, an American design that blazed the trail for our modern bombers.

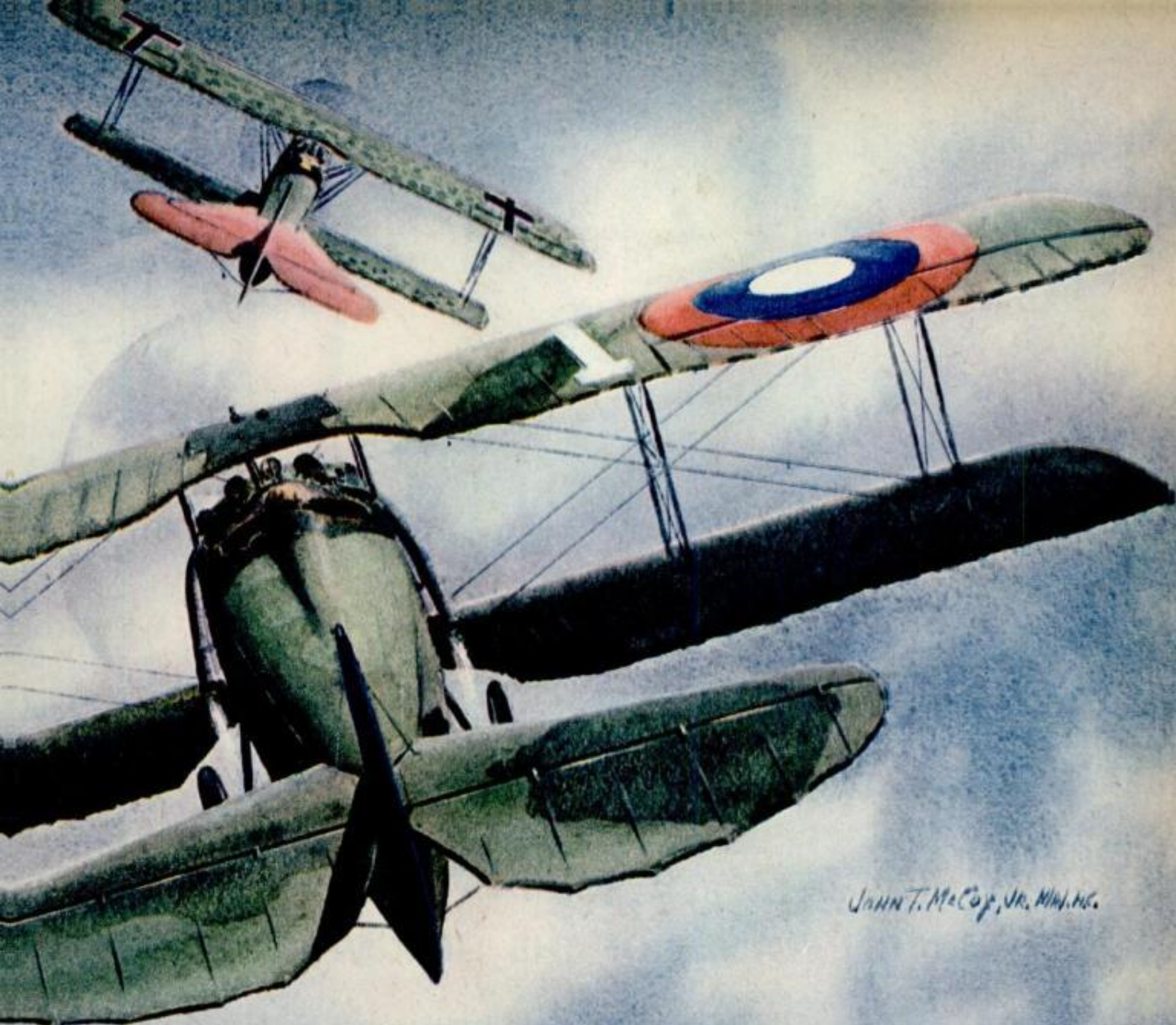


CURTISS J. N. 4

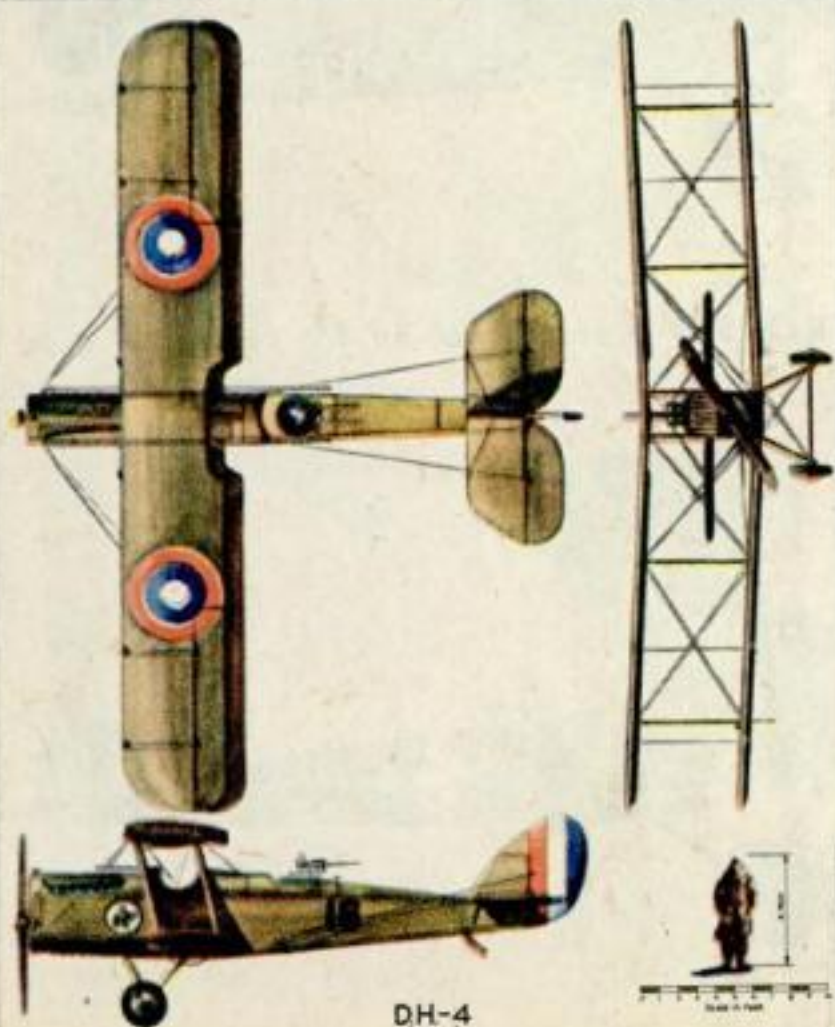


SPAD XIII

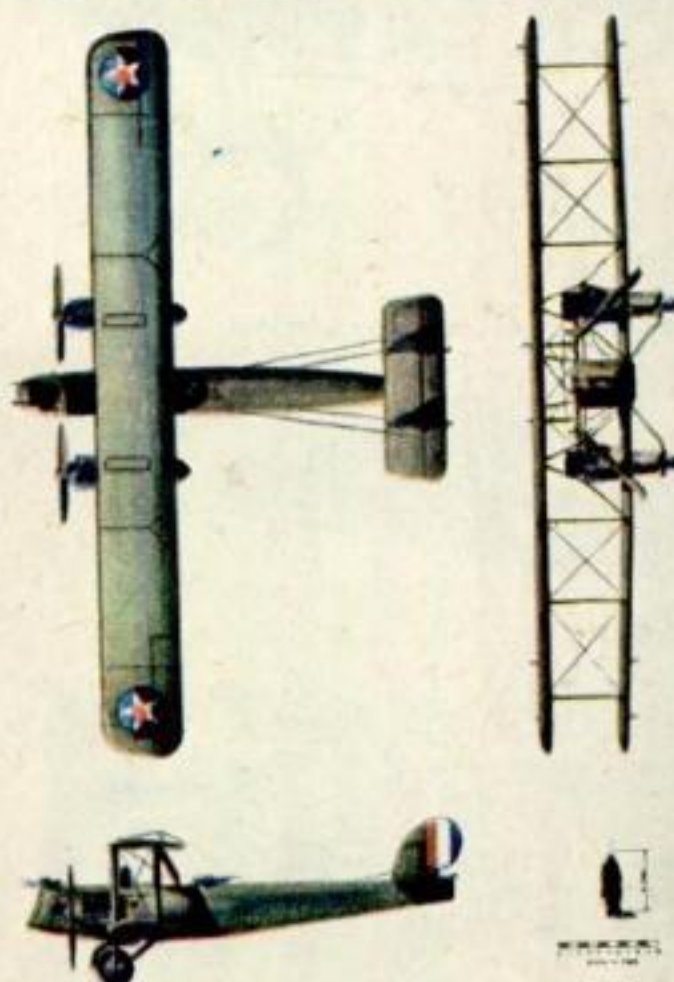




JOHN T. McCOP, JR. MINN. MS.



DH-4
(1917)

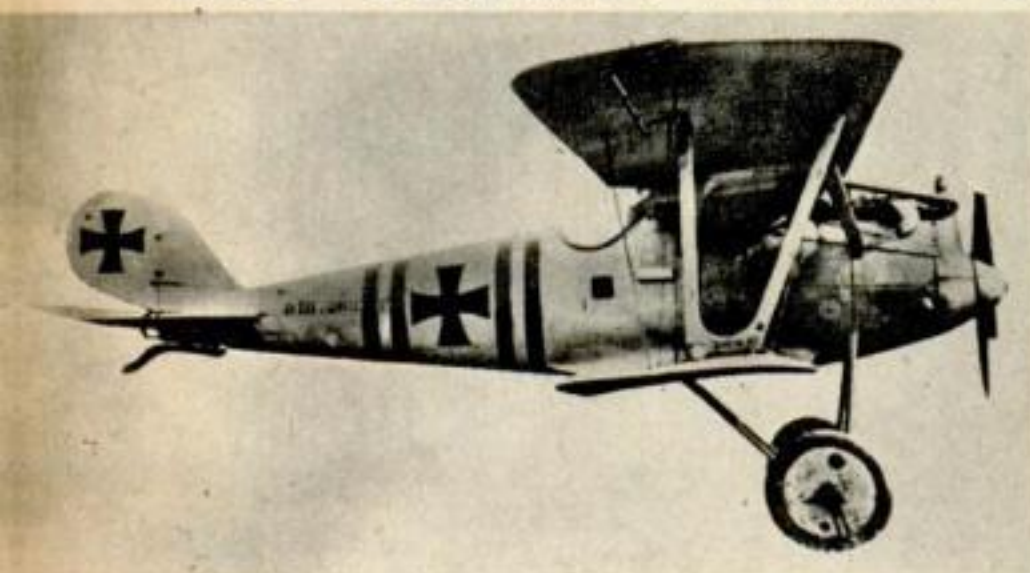


MARTIN MB-2



World War I fighters on the line. About a third of the U.S. pilots flying over enemy lines at the close of the war were British-trained. Two squadrons, the 17th and 148th, flew Sopwith Camel pursuits with Royal Air Force until a few days before the Armistice in November 1918, when they joined U. S. Second Army.

BEST GERMAN PLANES OF THE FIRST WORLD WAR



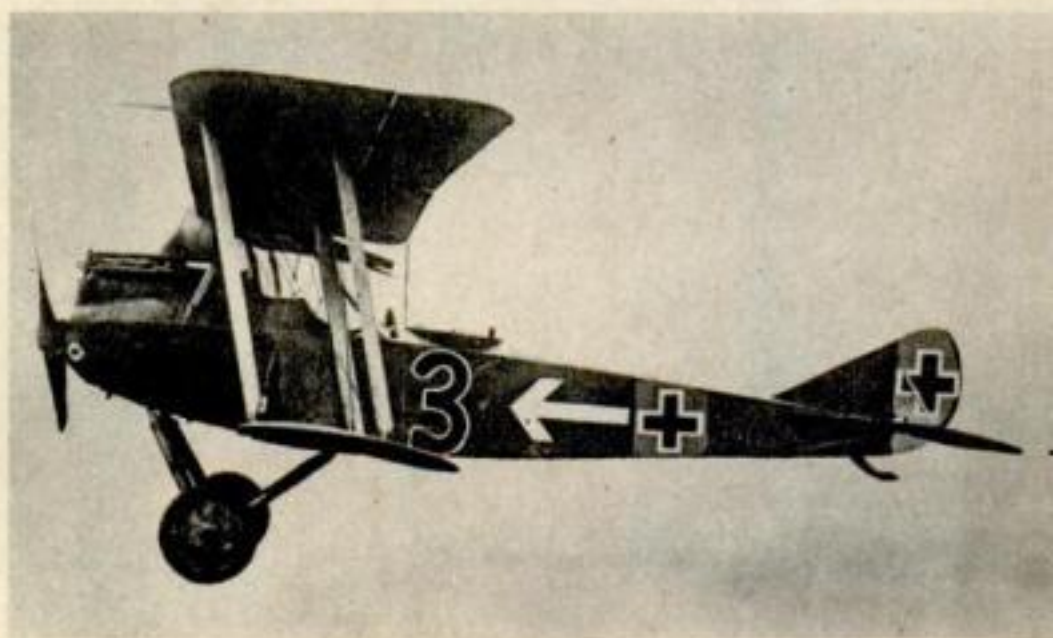
PFALZ D-3 pursuit. Siemens 160-hp. engine, 112 m.p.h.



ALBATROSS D-5 scout. 160-hp. Mercedes, 100 m.p.h.



FOKKER D-7 pursuit. BMW 185-hp. engine, 135 m.p.h.



RUMPLER two-seater observation, 260 hp., 109 m.p.h.



As late as the summer of 1918, the German Fokker pursuit was superior to anything the Americans were flying. Our contribution in aircraft design was limited, though we did develop the 12-cylinder Liberty engine. In combat we flew Sopwith, Spad, and Nieuport fighters; French Breguet and British de Havilland bombers.

"Black Jack" Pershing in pursuit of Pancho Villa in 1916, six crashed.

But the Signal Corps flyers were closer to the truth in their forecasts than those first tentative steps of military aviation indicated. By the time America entered World War I, in April 1917, British planes were fighting off zeppelin raids. Air duels between Germany's Fokkers and the Allies' Spads and Nieuports had tested the offensive possibilities of a weapon that was to help revolutionize the technique of warfare.

In airplane design and manufacture the contribution of the United States to the European air war was limited. We turned out some good training planes, notably the famous Curtiss JN or "Jenny" series. We developed the famous Liberty 12-cylinder engine. But in combat we flew British Sopwith and French Spad and Nieuport fighters, and French Breguet and British de Havilland bombers. American flyers in the AEF—many had cast their lot with the Allies before we entered the war—won their first victory on April 14, 1918, when Lt. Alan F. Winslow and Lt. Douglas Campbell brought down two German planes over the Toul airdrome. American squadrons took part in air operations at Chateau Thierry and participated in the climactic offensives of the

U. S. ACES: WORLD WAR I



Eddie Rickenbacker
(25 victories).



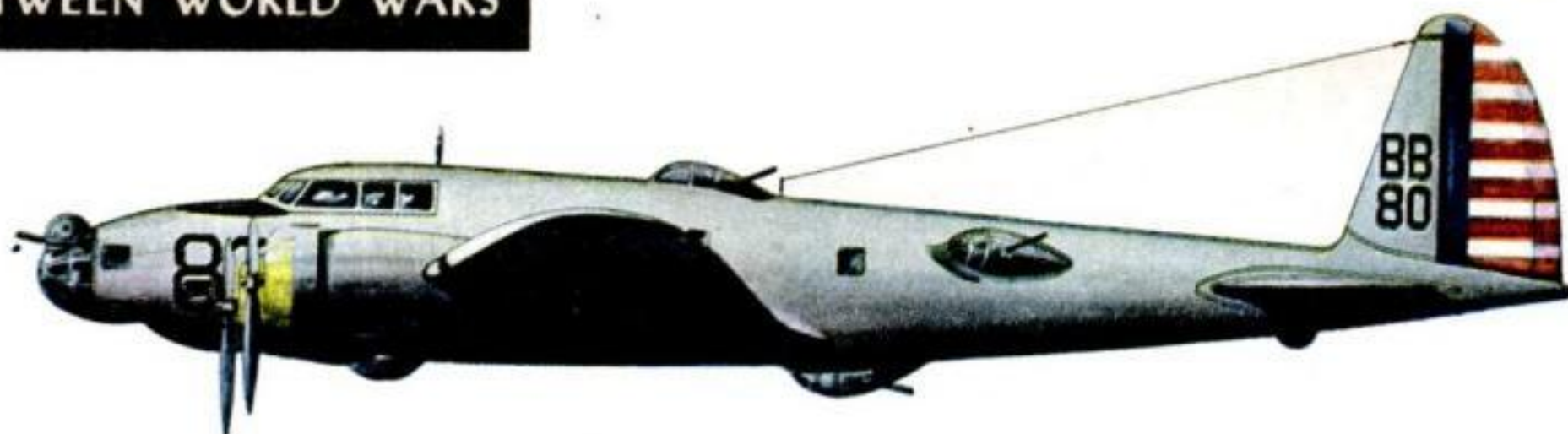
Frank Luke
(21 victories).



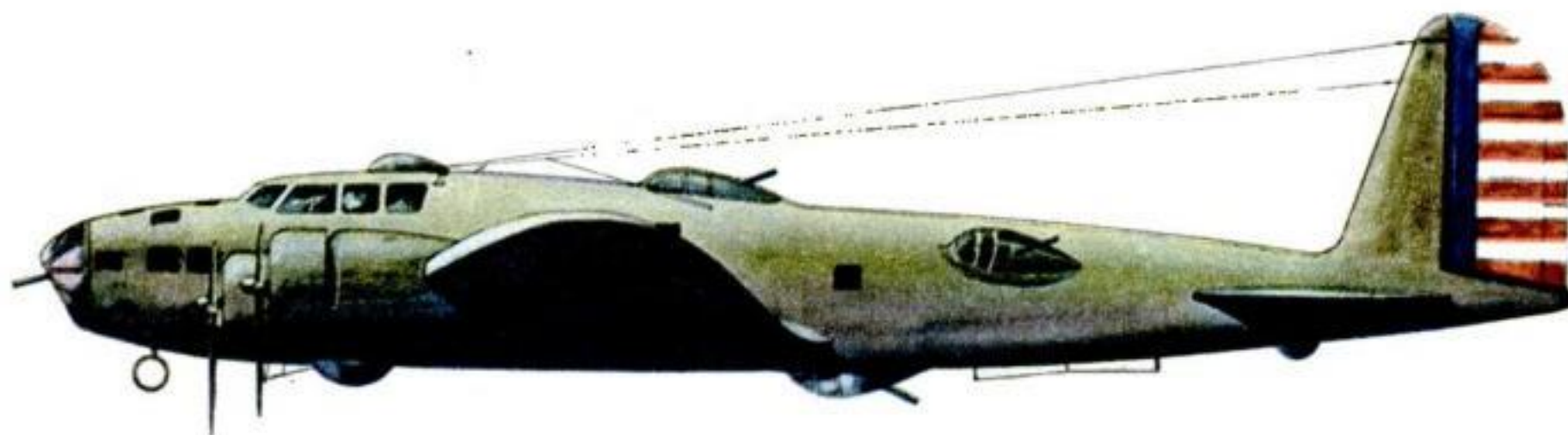
Raoul Lufberry
(17 victories).



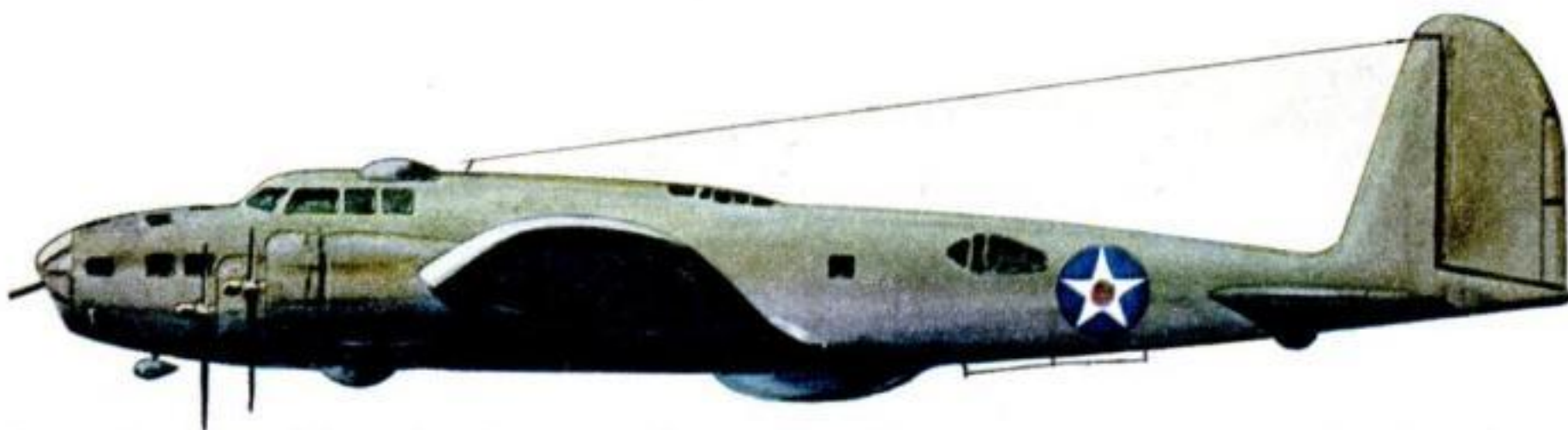
George A. Vaughn
(13 victories).



The original B-17, first flown in July 1935, revolutionized heavy-bomber design and shaped air-war strategy.



B-17B, second in the Flying Fortress series, differed from the prototype in that the engines were supercharged.



In the C and D models, produced a few months before Pearl Harbor, flush-type windows replaced blister turrets.

St. Mihiel salient and the Meuse-Argonne.

The aces of World War I, with stove lids as their only armor protection, flew to fame on less time in the air than the pilots of World War II had logged up to the end of their training. But American airpower had been incubated. Before the Armistice stilled the guns, a raid by more than 200 escorted American bombers showed the shape of things to come. Though it was produced too late for combat, a Martin twin-engine bomber (MB-2), carrying a crew of two or three, indicated the trend of American military thinking.

Between wars, while an evangelist named Billy Mitchell stalked up and down the land

preaching the future of airpower, American airmen fought tradition and pinch-penny economy to keep an air force in being. Mitchell-directed Army bombers sank a modern battleship and three other warships to show it could be done. Two Army pilots, Oakley G. Kelly and John A. Macready, spanned the continent nonstop. Another did it between dawn and dusk. Two Army planes girdled the globe after British, Italian, Portuguese, French, and Argentine planes had failed. Still another made the first flight between California and Hawaii. Jimmy Doolittle—the same Jimmy Doolittle who was to bomb Tokyo from “Shangri La” 17 years later—flew 245.7 miles an hour in

HOW THE FLYING FORTRESS GREW



The fuselage lengthened with the B-17E. This plane had a gunner's post in the tail, and power-operated turrets.



The chief difference in the B-17F, which came along a few months after Pearl Harbor, was a longer Plexiglas nose.



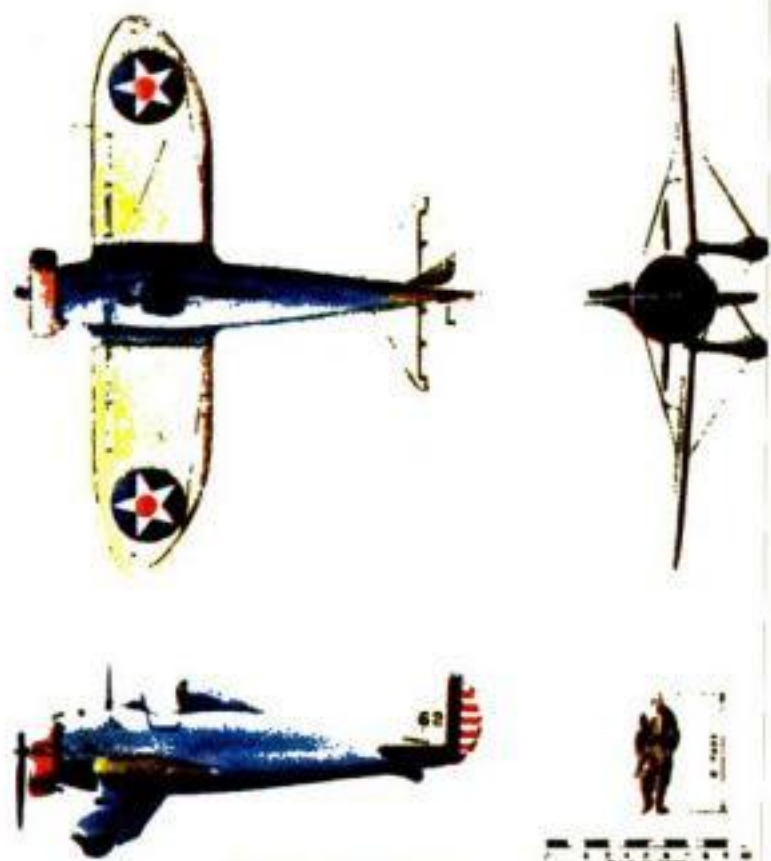
B-17G added a remote-control chin turret for more protection. This also was the first with external bomb racks.

a dramatic demonstration of the airplane's new speed.

The framework of American air-warfare philosophy was gradually taking form. In 1935 the General Headquarters Air Force, designed as a swift-striking defensive organization that could move to any point in continental United States on short notice, was created. In the same year the Army accepted its first heavy, four-engine bomber, the Boeing Flying Fortress. It marked a new epoch in American military aviation. This experimental B-17 made history with a 2,100-mile nonstop flight from Seattle to Dayton, averaging 232 miles an hour. After that, the development of heavy bombardment techniques was only a matter of refinement and a sufficiency of planes.

While the United States, with its vast land area and long coastlines, was committing itself to the heavy

The Army's first all-metal fighter, the Boeing P-26, was brought out in 1932. It had a fixed landing gear.



BOEING P-26



Chennault's Flying Tigers gave a boost to American morale in the dark days after Pearl Harbor, when the Japs were sweeping everything before them. Flying outmoded P-40's against average odds of nine to one, they won every air combat they entered from their first encounter on December 20, 1941, until they were disbanded on July 4, 1942. They downed 287 Jap planes, with as many probables, lost only eight pilots.

bomber as a primary weapon of air defense, the medium bomber and the fighter were not being neglected. From the open-cockpit Boeing P-26 of 1932, the Army's air arm—which with divorcement from the Signal Corps in its infancy successively became the Air Service, the Air Corps, and finally the AAF—progressed to faster, bigger, more heavily armed single-seaters. There came in rapid succession the Republic P-35, the Curtiss P-36, the Bell P-39, the Curtiss P-40, the Republic Thunderbolt (P-47), the Lockheed Lightning (P-38), the North American Mustang (P-51), and the Nor-

throp Black Widow (P-61) night fighter.

From experience with the poky but sturdy Martin MB-2, the Fokker T-2, the Douglas World Cruiser, and that old "coal-burner," as the pilots knew it—the Keystone bomber—came the North American B-25 and the Martin B-26, more than twice as fast as the pursuits of World War I. It was B-25's that dropped the first American bombs on Japan. It was B-26's that did such a noble job in helping disrupt Nazi communications in France prior to the invasion of Fortress Europe.

Japan's blow at Pearl Harbor on Decem-

Early in 1942, the U. S. Far East Air Force and allied air forces held back the enemy advance in the southwest Pacific. The Fifth perfected its bombing technique at Wewak and Hollandia, annihilated a Jap convoy

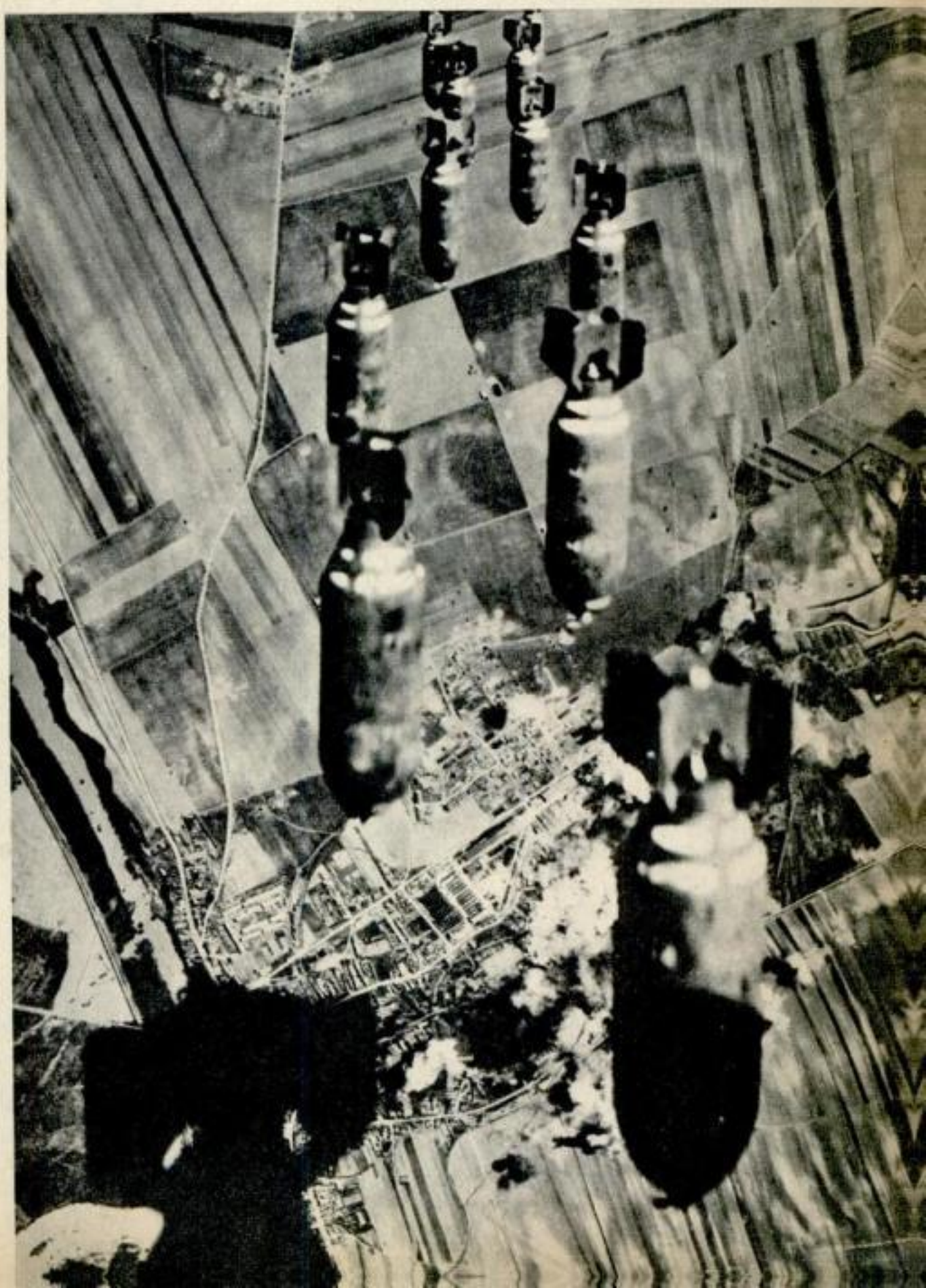




To Europe went our heavy bombers, to help in the task of softening up Germany by daylight attacks on industrial targets. The American theory of precision bombing got its acid test in the flak-filled skies above Nazi war plants.

In the months preceding the storming of Fortress Europe, Allied air forces paved the way. Here American bombs are plummeting down on the Messerschmitt fighter factory at Wiener Neustadt. By D-day, the Luftwaffe was only a nuisance.

in the Bismarck Sea. In the latter action, 15,000 Japs died.

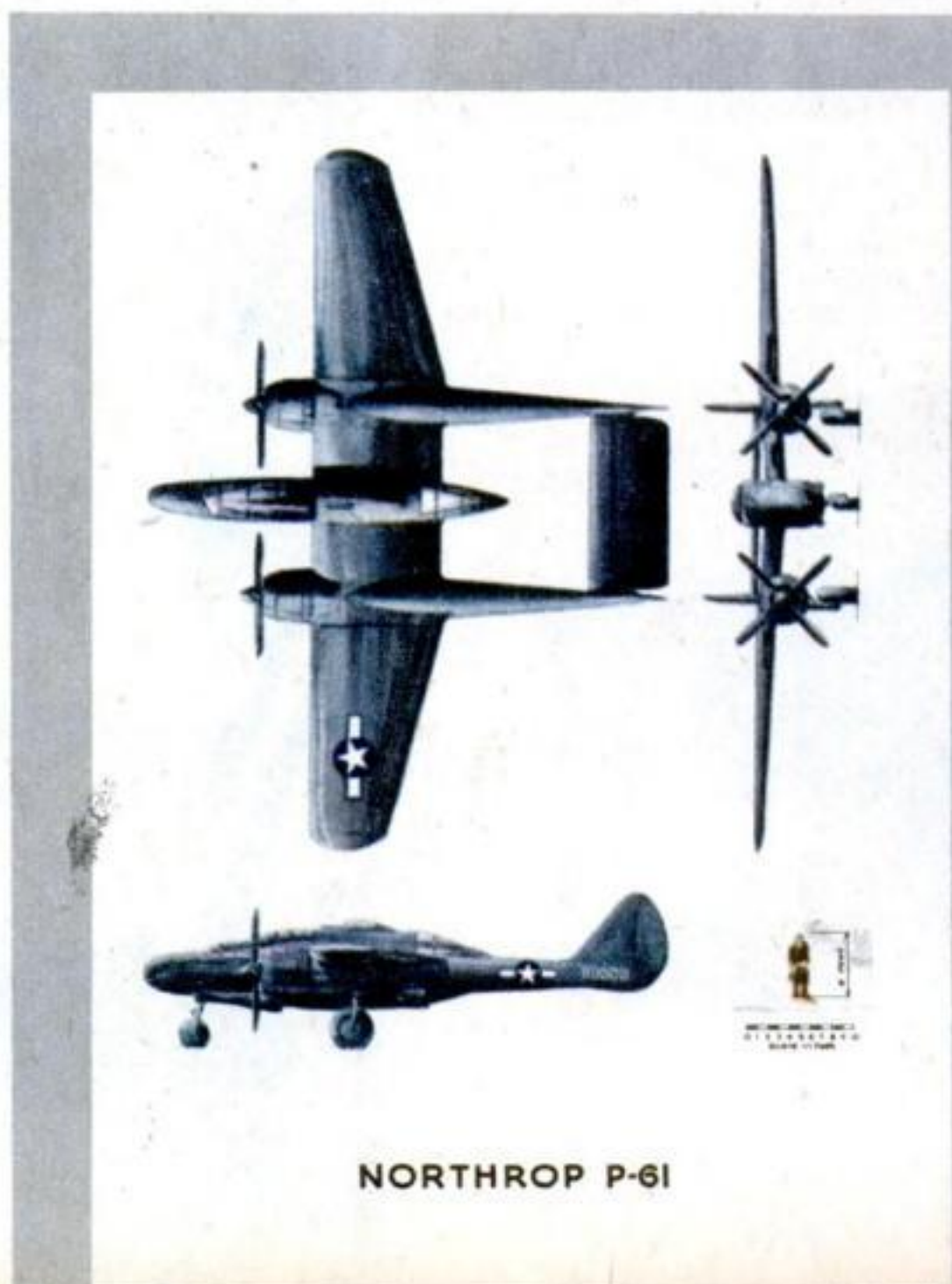




Telling blows by the Eighth and Fifteenth Air Forces in February 1944 crippled the Luftwaffe by destroying plane factories. Above: Liberators headed for the target.

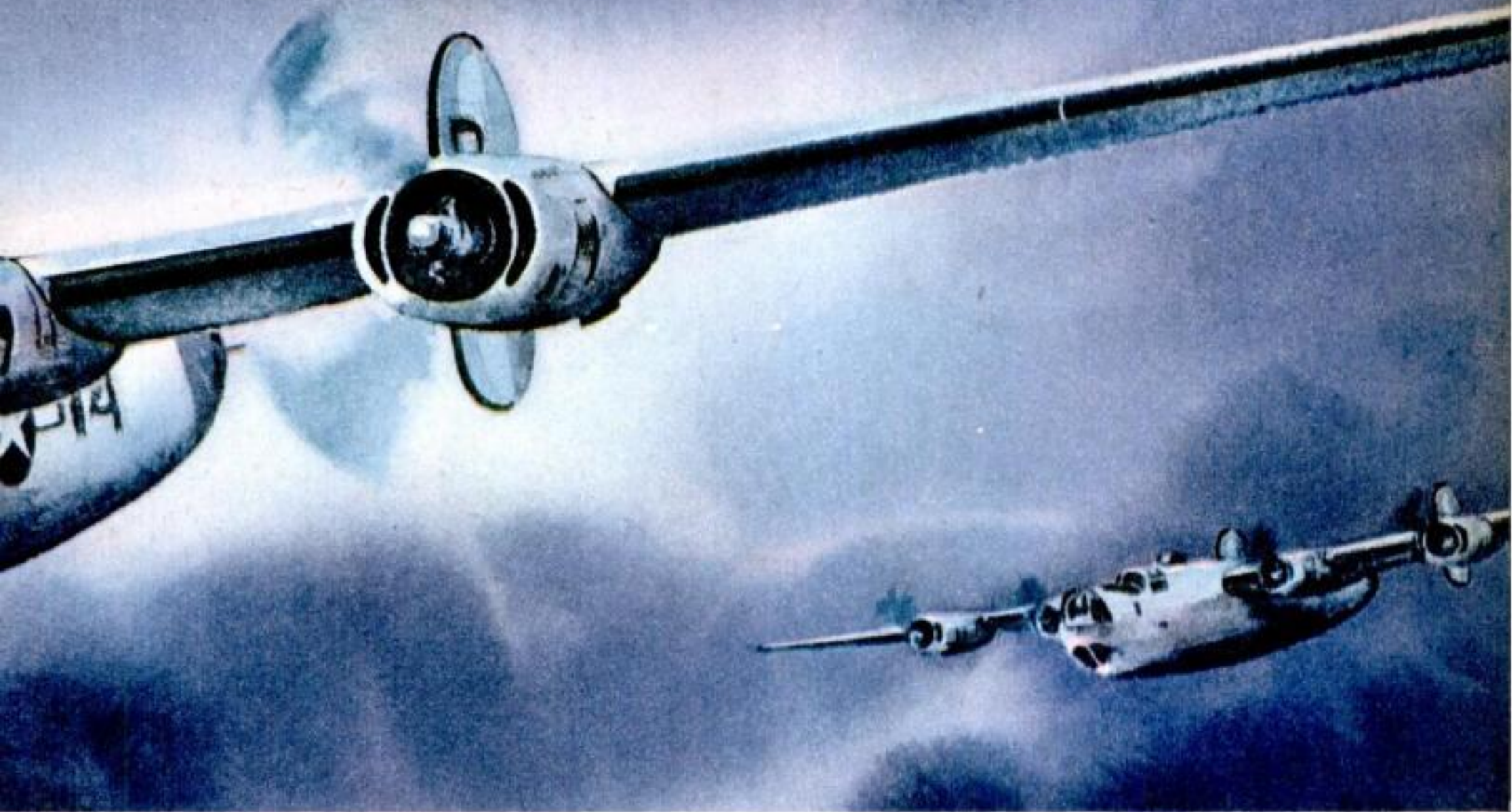
ber 7, 1941, while shocking, was only an epilogue to the Nazi march through Poland, the invasion of Norway, the fall of France, the subjection of the Balkans, and the airborne capture of Crete. Airpower in its cumulative form had been loosed on the world. It was an offensive weapon, but it was also a defensive weapon. The Royal Air Force had proved that over London and the beaches of Dunkirk.

In the dark days that followed Pearl Harbor there were two bright spots—the achievements of the Flying Tigers, the American Volunteer Group, against the Japs in China and Burma, and Doolittle's raid on Japan on April 18, 1942. Airpower was proving to be something more—a factor in the national morale. American airmen could fight—even in equipment whose performance left something to be desired. At no time could the *(Continued on page 192)*

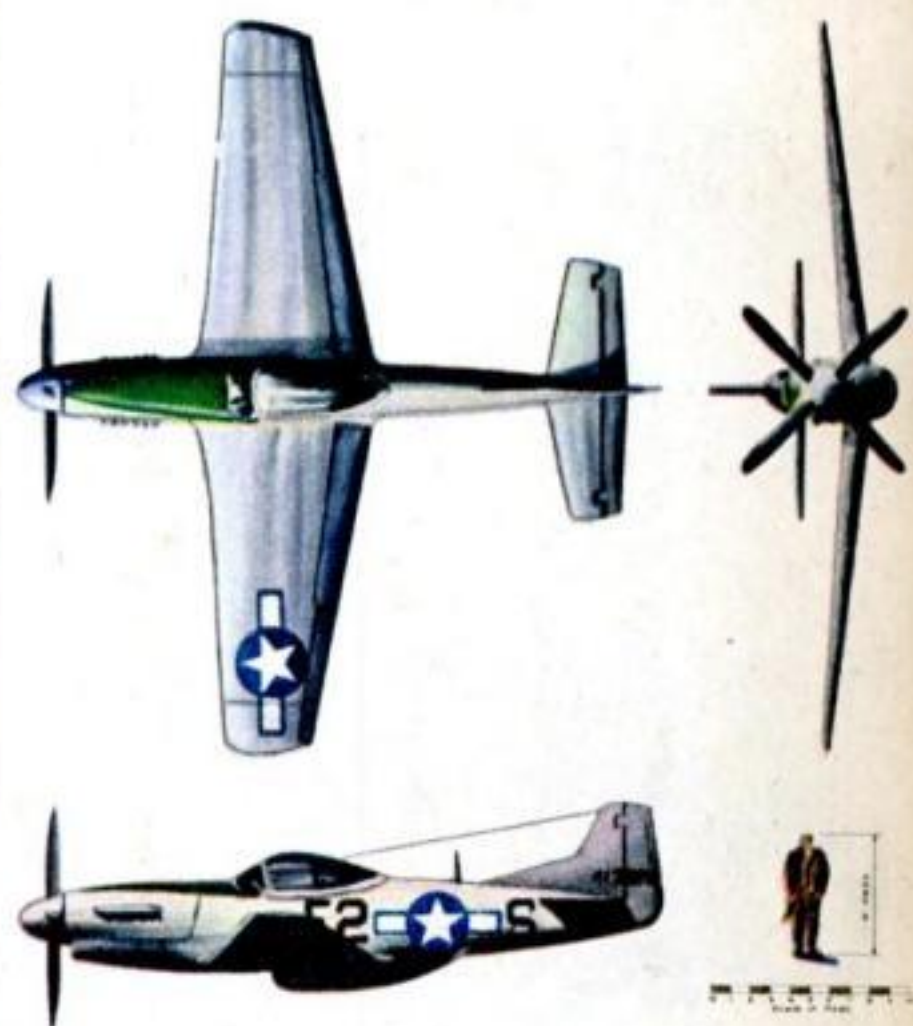


NORTHROP P-61

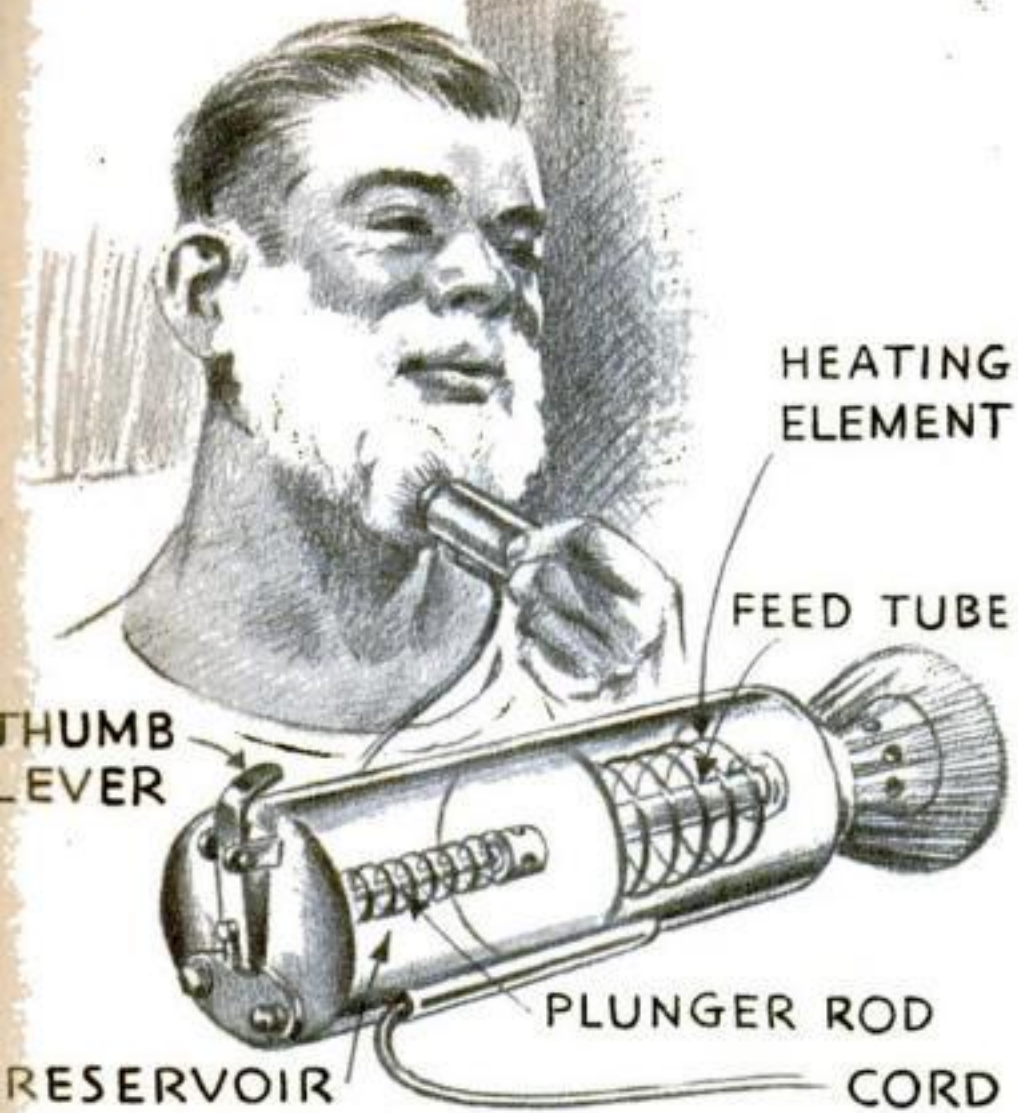
AIR WAR (continued)
WORLD WAR, II



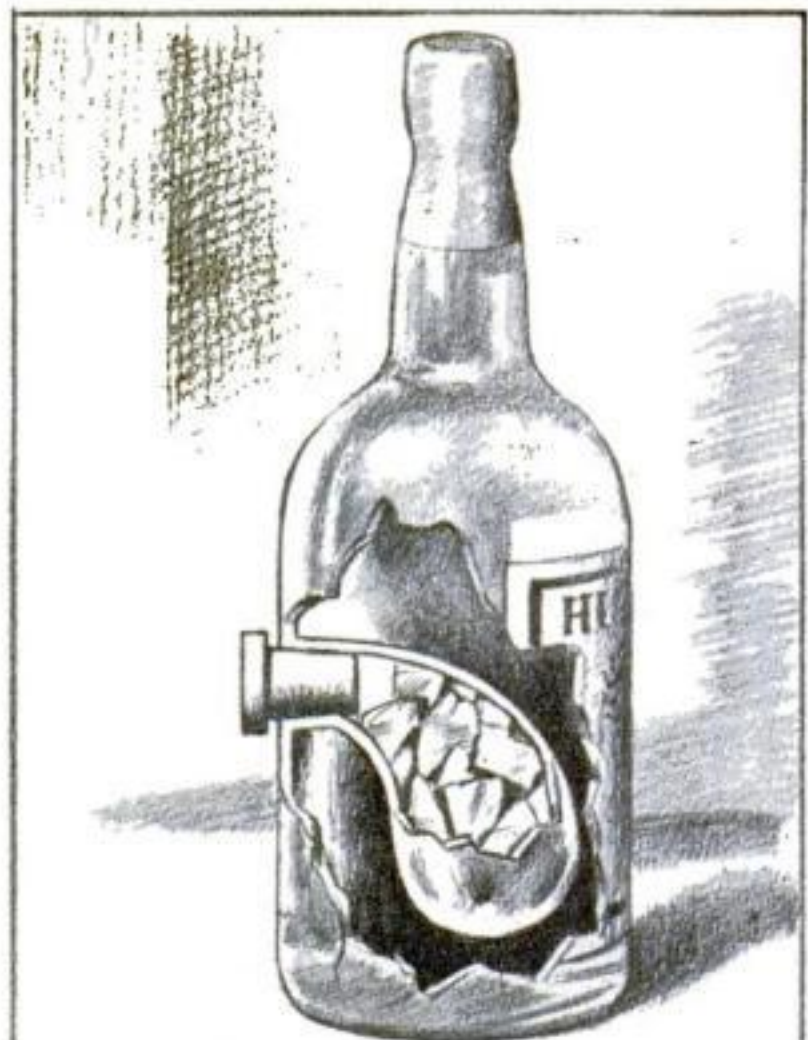
CURTISS P-40N



NORTH AMERICAN P-51

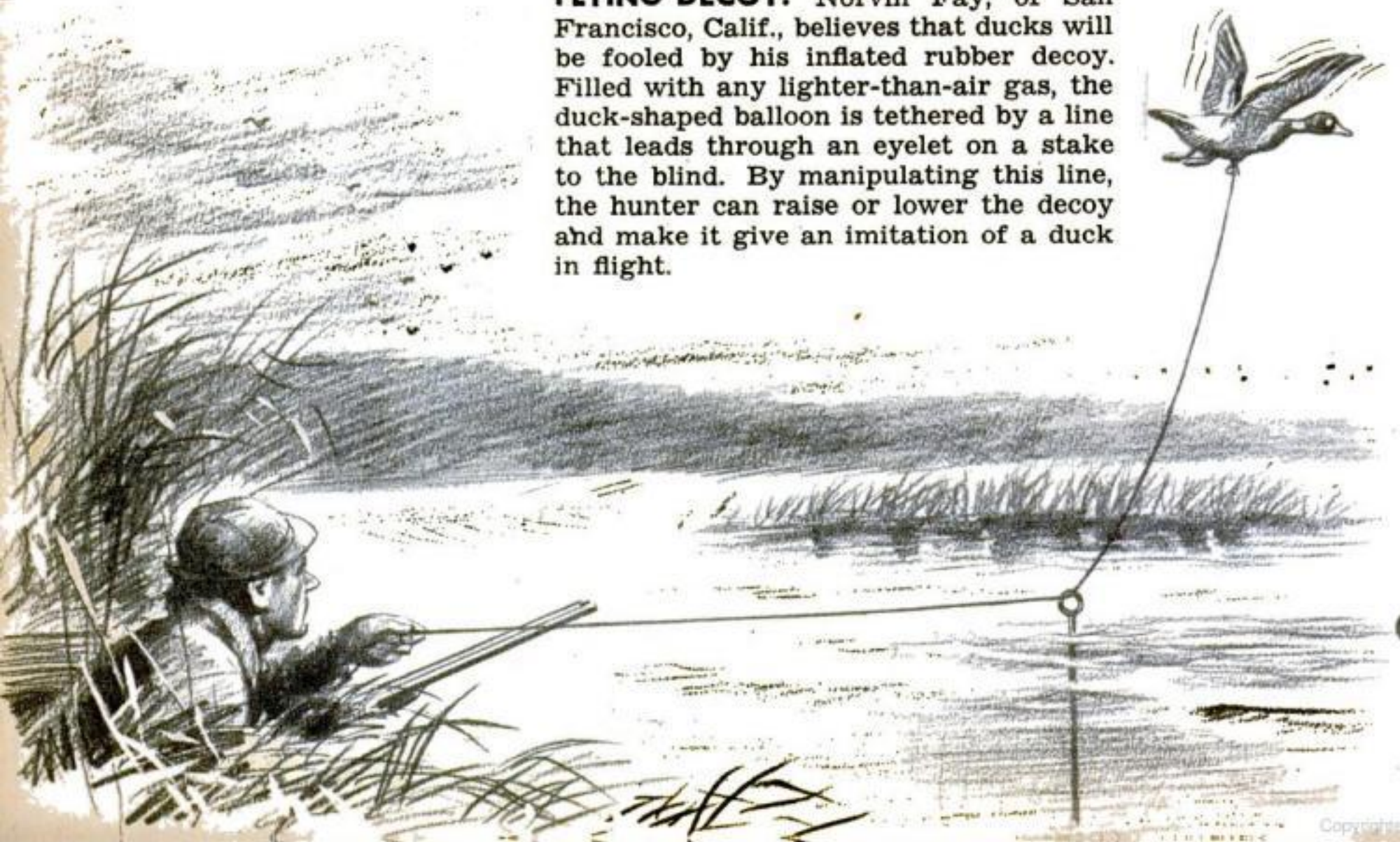


HOT LATHER is fed to a shaver's face by a fountain shaving brush invented by Peyton Rowan, of Anniston, Ala. From a reservoir in the handle, a mixture of soap and water is forced through a feed pipe by a plunger when the user presses a thumb lever at the end. Electric heating wires around the feed pipe warm the soapy water as it passes through to a distributing head set in the bristles. The distributor also gives a massaging effect in working up a lather. Current for the heating element comes through a cord plugged into an outlet.



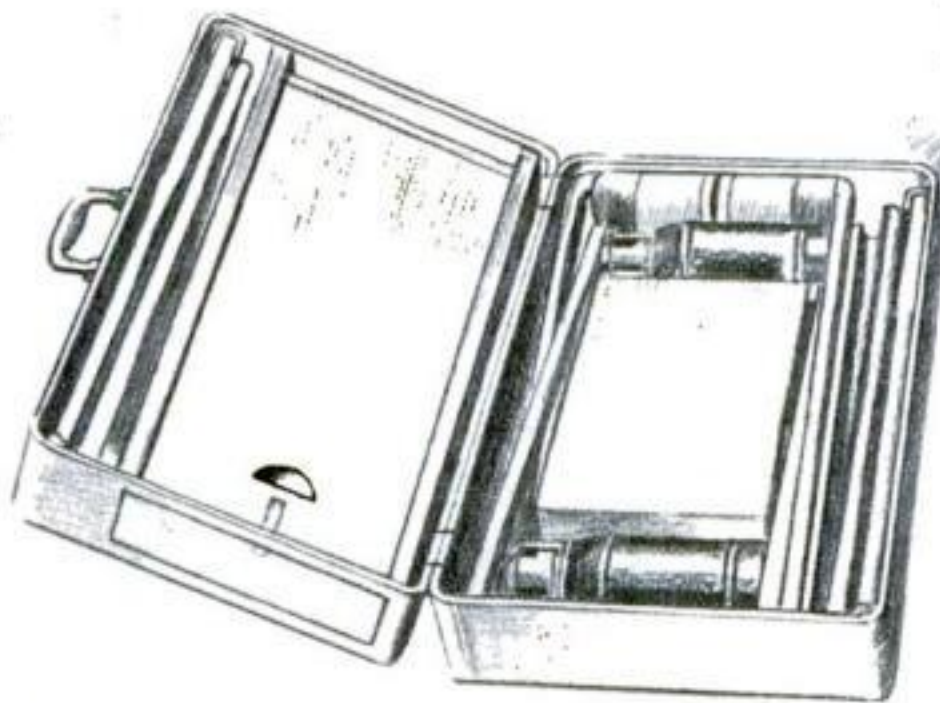
COOL DRINKS come from this bottle, which has a blown-in ice chamber opening from its side. Originated by Daniel Platkin, of Los Angeles, Calif., the idea can also be applied to decanters, jugs, and other containers for beverages. The inventor foresees special usefulness for cooling drinks at picnics and barbecues.

FLYING DECOY. Norvin Fay, of San Francisco, Calif., believes that ducks will be fooled by his inflated rubber decoy. Filled with any lighter-than-air gas, the duck-shaped balloon is tethered by a line that leads through an eyelet on a stake to the blind. By manipulating this line, the hunter can raise or lower the decoy and make it give an imitation of a duck in flight.



from the inventors

FOR PICNICS, Henry Rothschild, of New York City, has designed a table that folds up like a Gladstone bag for carrying. The legs, which fold into the case like those of a card table, are securely locked when open to prevent unintentional collapse. One half of the case is occupied by a drawer for plates, cups, knives, forks, and spoons. The other half holds two folding chairs. The outfit is easily carried with a handle like a suitcase.



ARM WITH
LATCH



SLOT

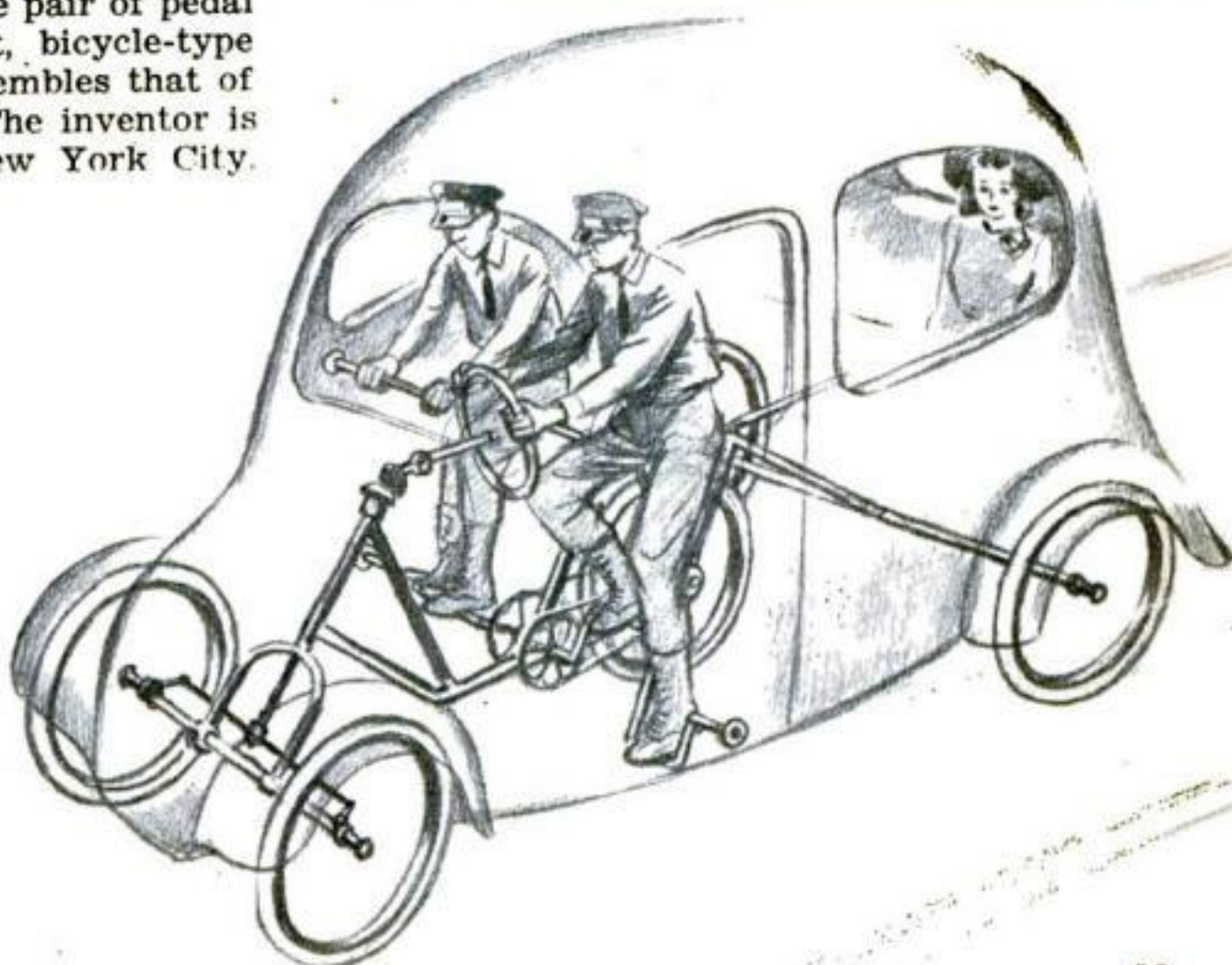
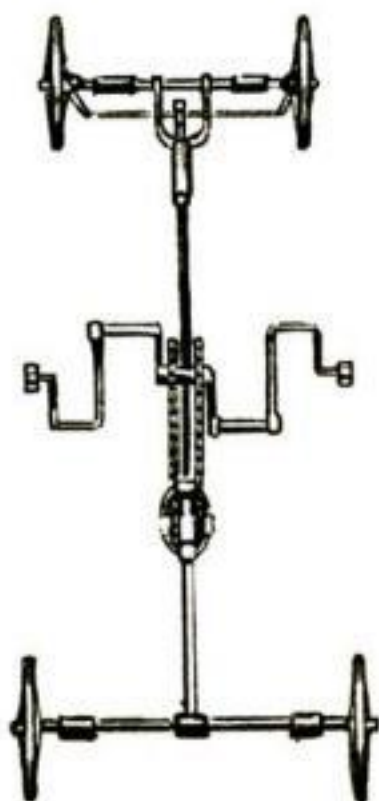
NOTCHES

PRESS DOWN



NO GAS COUPONS are needed to operate this legpower car. Pedals turn sprocket wheels connected by chains to a drive wheel located at the center of the vehicle. Either one or two persons may pedal; when one, he sits in the center and uses the inside pair of pedal cranks. Riding on light, bicycle-type wheels, the car body resembles that of a gas-powered sedan. The inventor is Solomon Axelrod, of New York City.

CHOOSE YOUR STONE, and the jeweler attaches it promptly to the ring, brooch, or pendant that you want. Interchangeable settings are the invention of Mitchel Fitzer, of New York City.



The Air's the Place to Fight



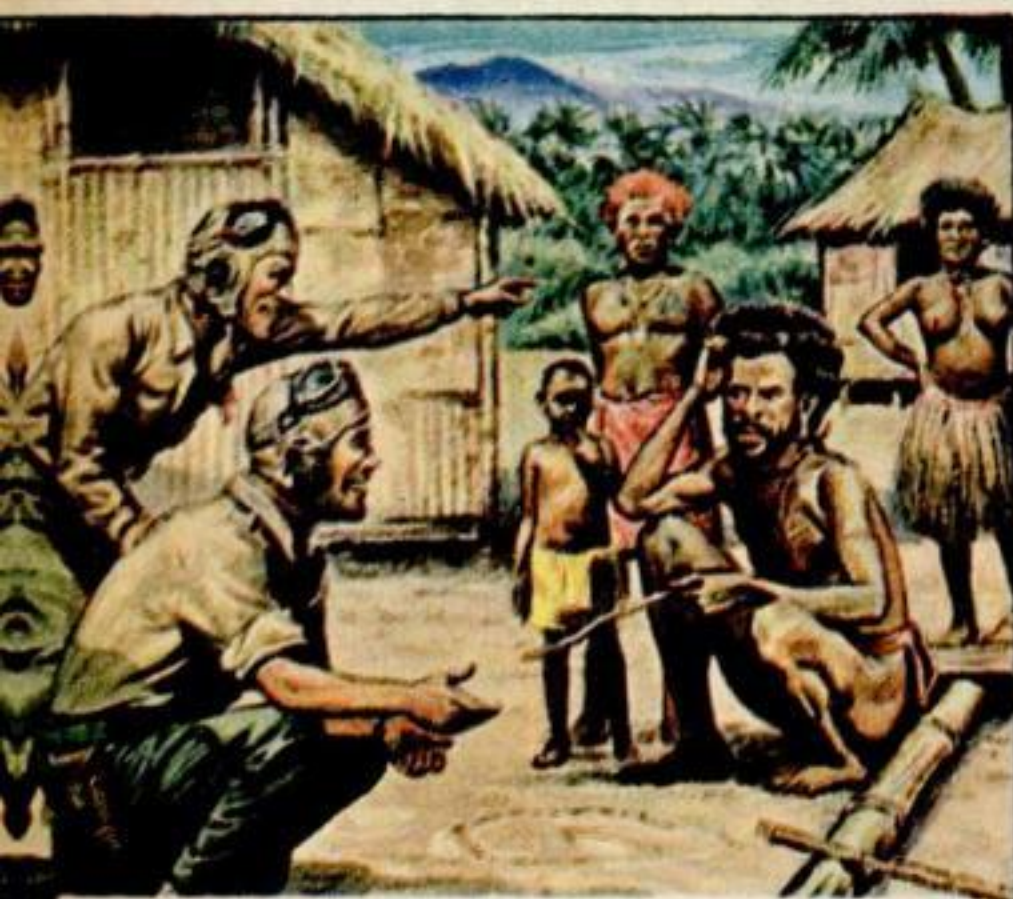
Dive-bombing the Japs was easy for these leatherneck flyers; it was getting back that was tough. The trip gave them a taste of life in the "splinter fleet"—and convinced them that they still liked planes best.

By FRANK TINSLEY



CAPT. GEORGE B. HERLIHY
USMCR

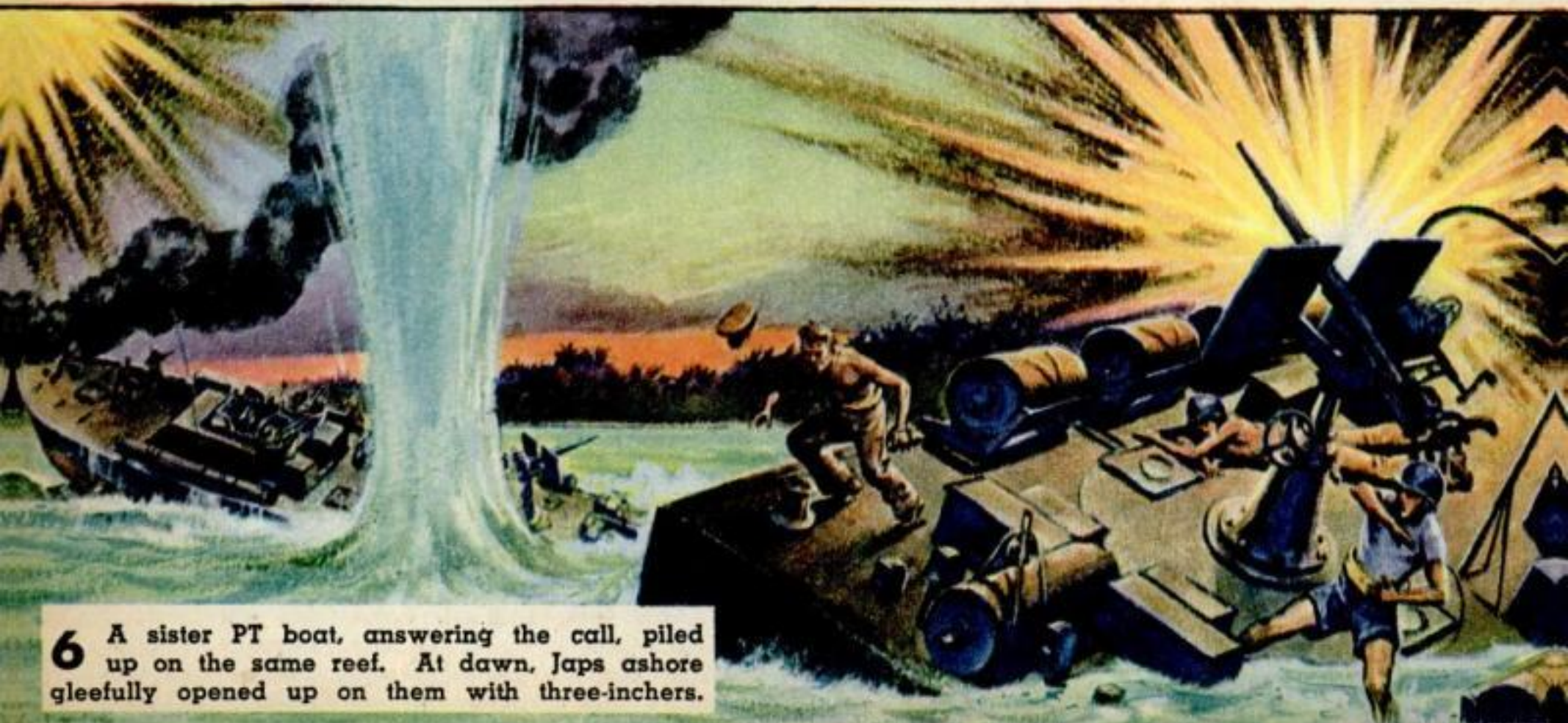
S/SGT. ORVILLE SIMMONS
USMC



3 In a native village, they found a man who spoke pidgin English. The news was bad: heavy fighting between them and their base.



4 A few days later, they started home in a native canoe. They ran into three PT boats at nightfall and climbed aboard one.



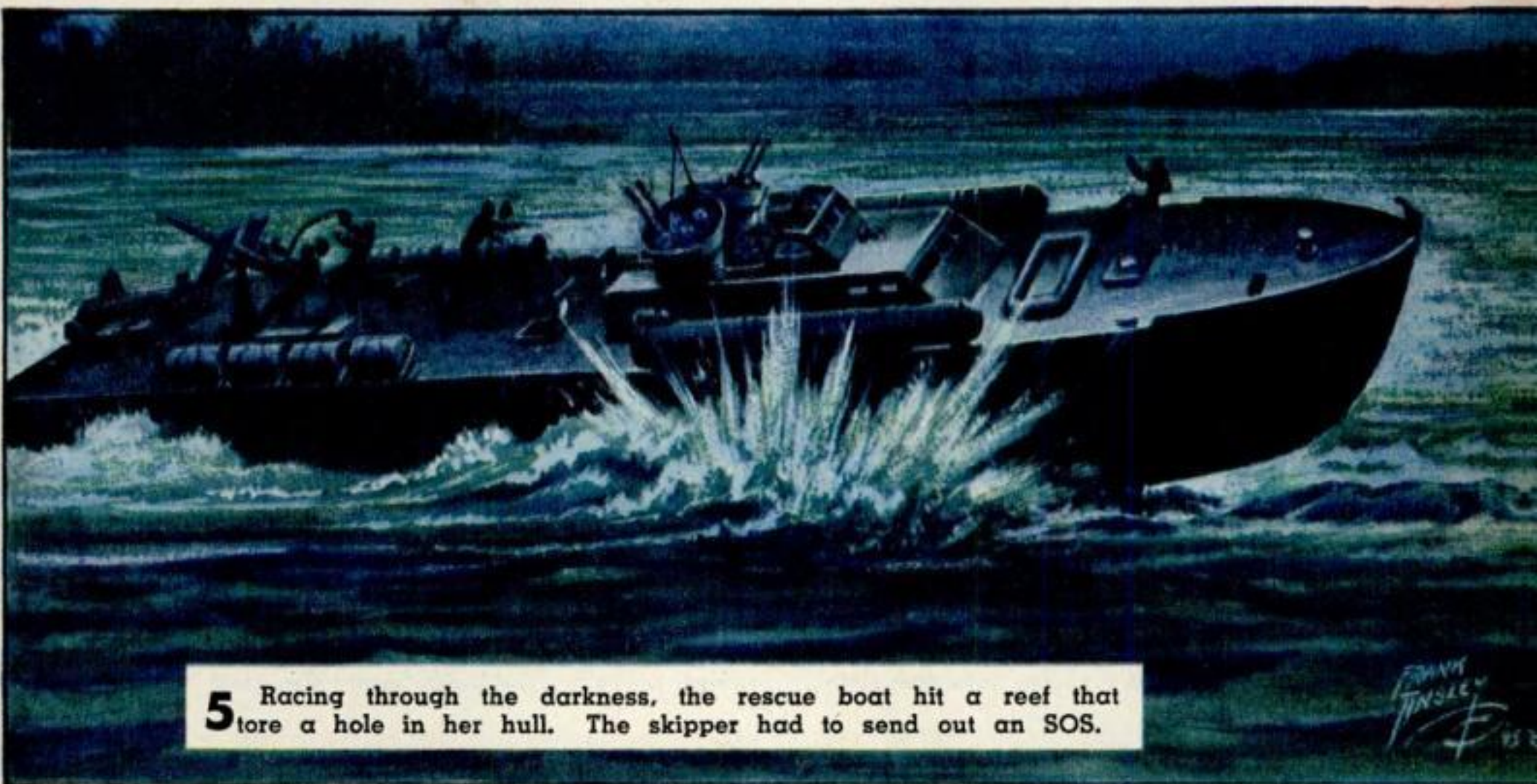
6 A sister PT boat, answering the call, piled up on the same reef. At dawn, Japs ashore gleefully opened up on them with three-inchers.



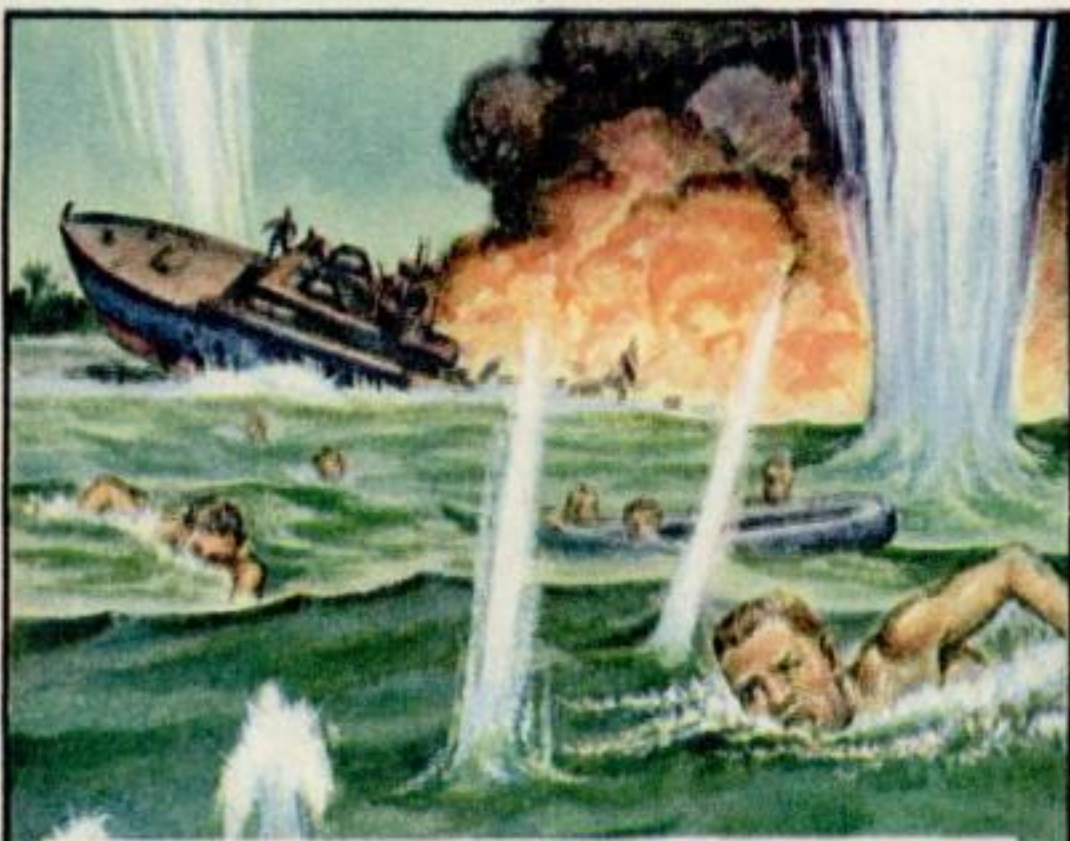
1 Heading home from a dive-bombing mission, pilot Herlihy found his oil pressure down to zero and his bearings burning up. He eased the SBD onto a wave crest as the engine froze.



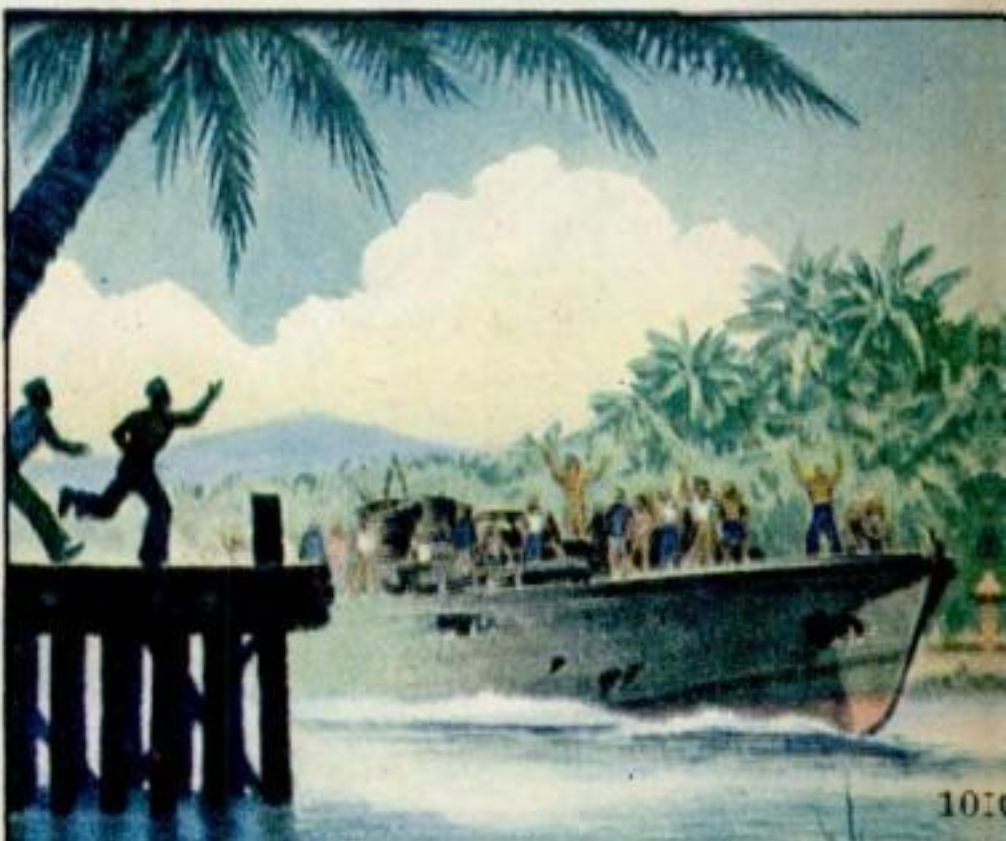
2 Fighting clear of the sinking plane, Herlihy and his gunner, S/Sgt. Orville Simmons, inflated their life raft. Battling through heavy surf, they capsized but reached an island safely.



5 Racing through the darkness, the rescue boat hit a reef that tore a hole in her hull. The skipper had to send out an SOS.



7 In a hail of shells, Herlihy, Simmons, and the crews of the two boats went over the side and swam through the shrapnel-torn surf to the third PT, which zigzagged off with them to safety.



8 Five days later, the two leatherneck flyers staggered ashore at their base, resolved in the future to stick to the air—where they'd be high and dry.

Doom for Deadly Shipwreck Rock

FOR two years, Canadian engineers have been struggling to anchor a drilling barge to cut down Ripple Rock. This is a ship-

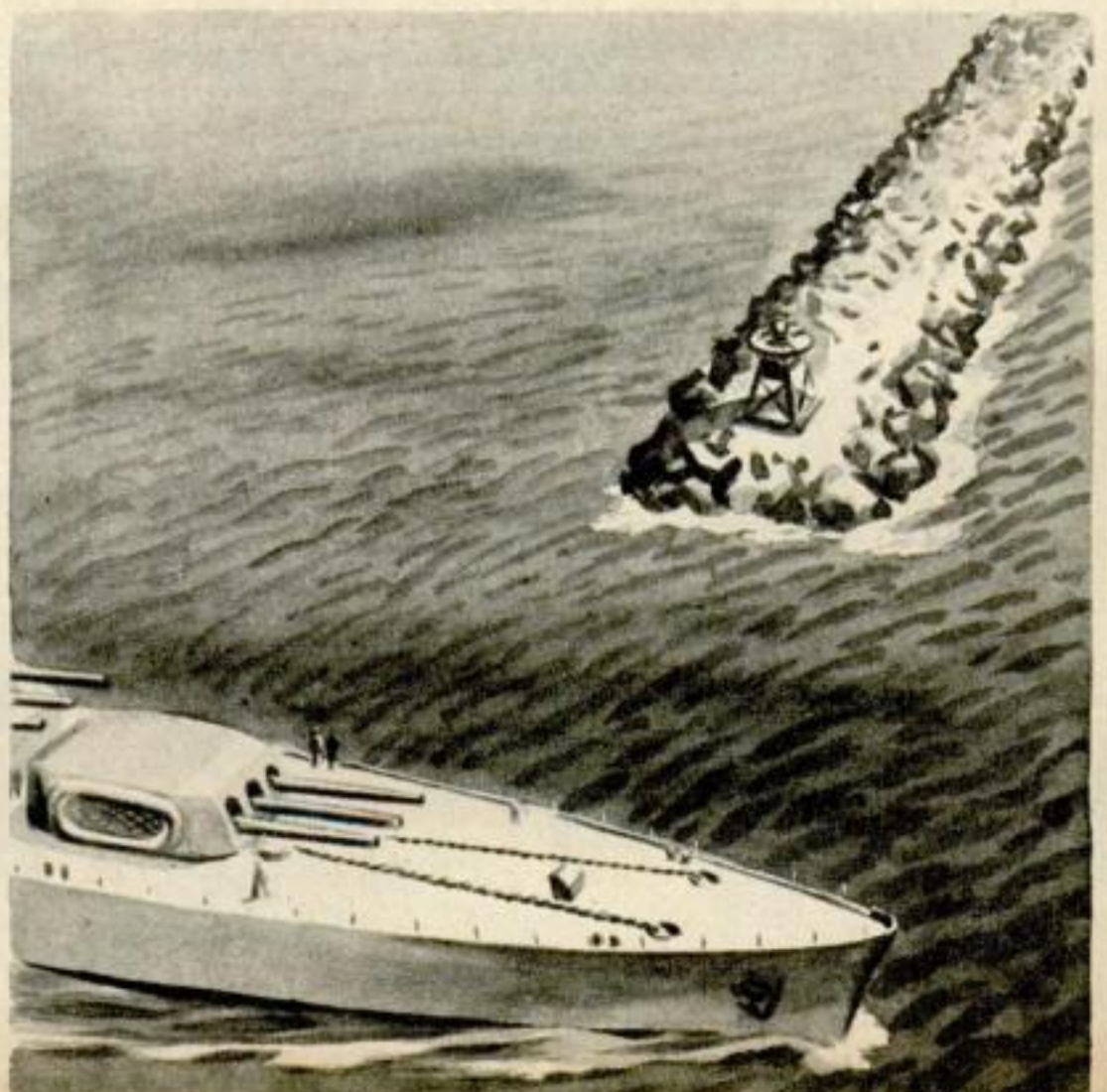
destroying obstacle hidden in the waters between Vancouver Island and the mainland, on the vital water route to Alaska.

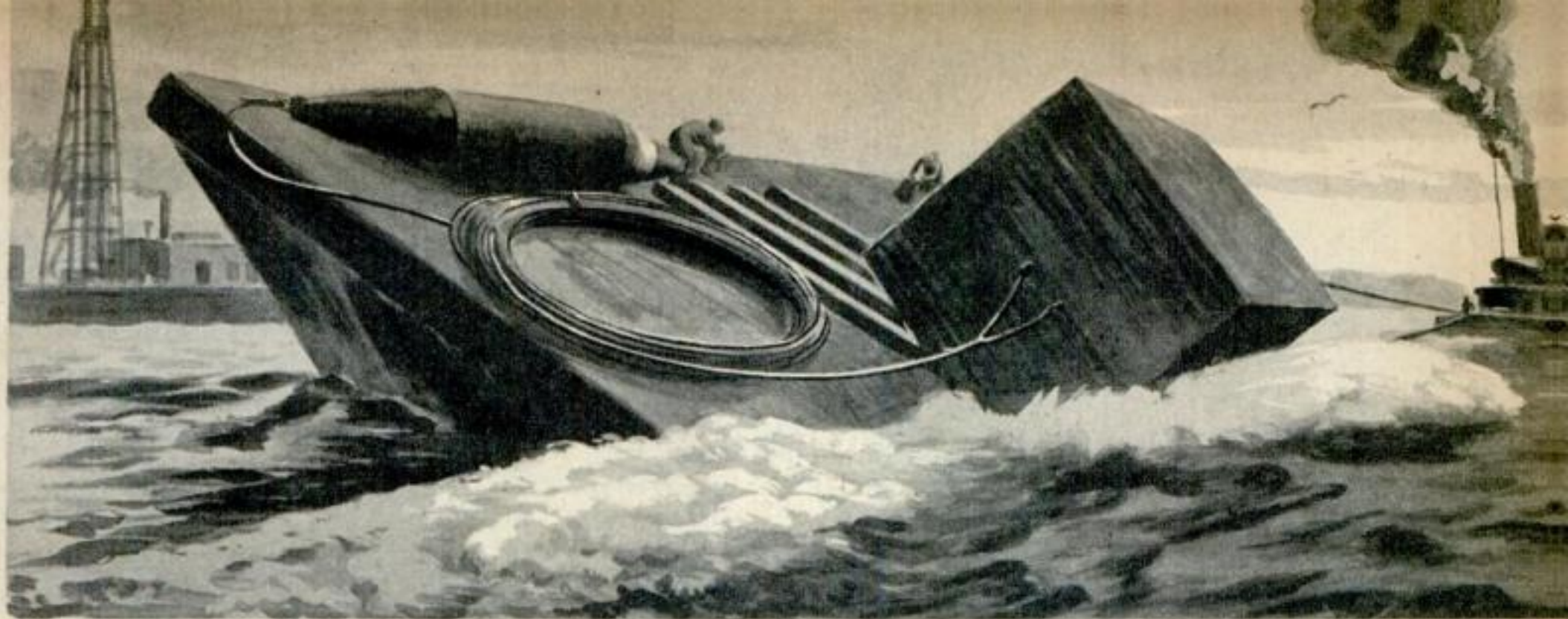


1 GIGANTIC WHIRLPOOLS and eddies in a current known to race at 20 knots have forced warships and freighters to crash against Ripple Rock. This obstruction, which has 19 pinnacles and lies under only nine feet of water at low tide, is a constant threat to the thousands of vessels that use this inland channel to supply our bases in the North Pacific. Calm water prevails here for less than an hour a day.

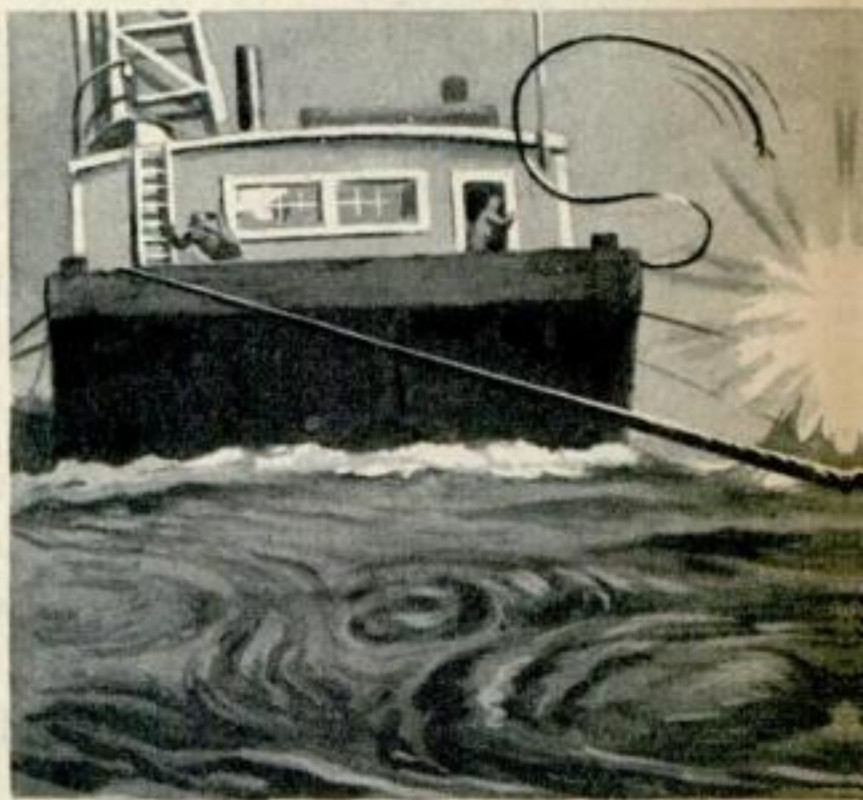
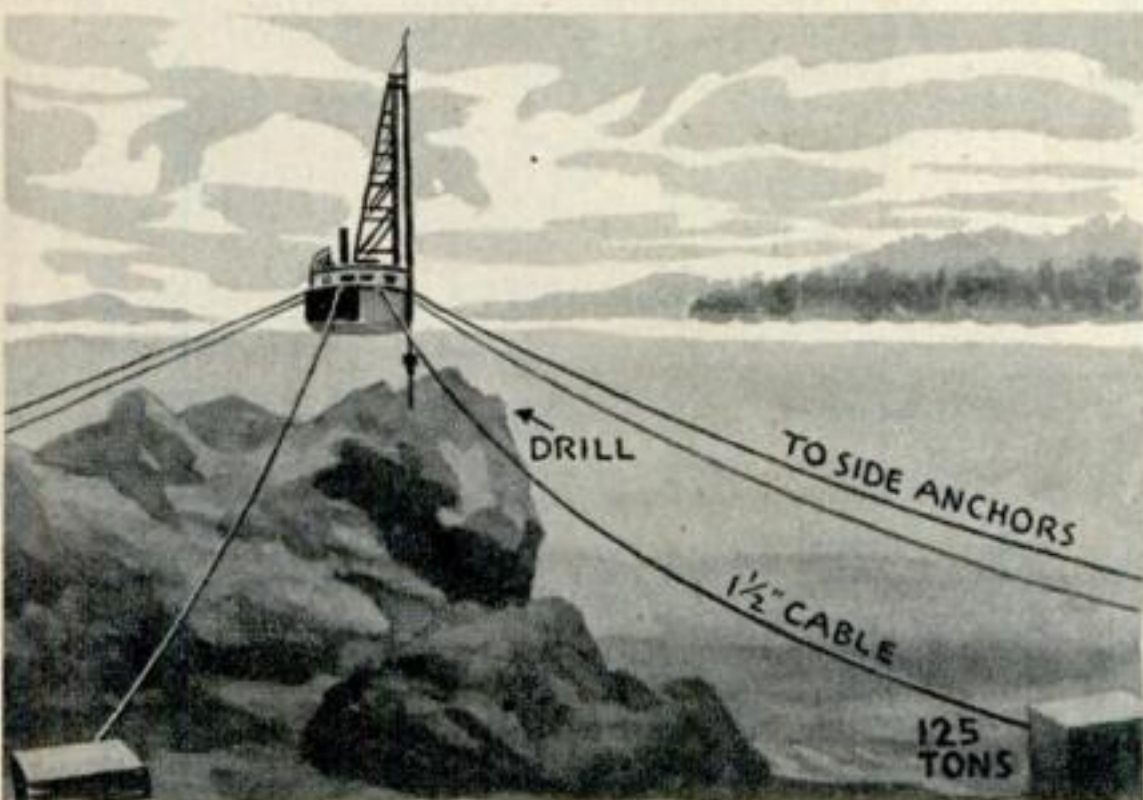
2 A ROCK BARRIER was projected in July 1942, to counter a lesser tiderace between Maud and Quadra islands, 1,600 feet from Ripple Rock. Ten-ton rocks were spilled into the water.

3 THIS CAUSEWAY, jutting out 250 feet into the 2,400-foot-wide channel, is doing its job of countering a current which had been driving ships against the rock. The U.S.S. Saranac was lost here.





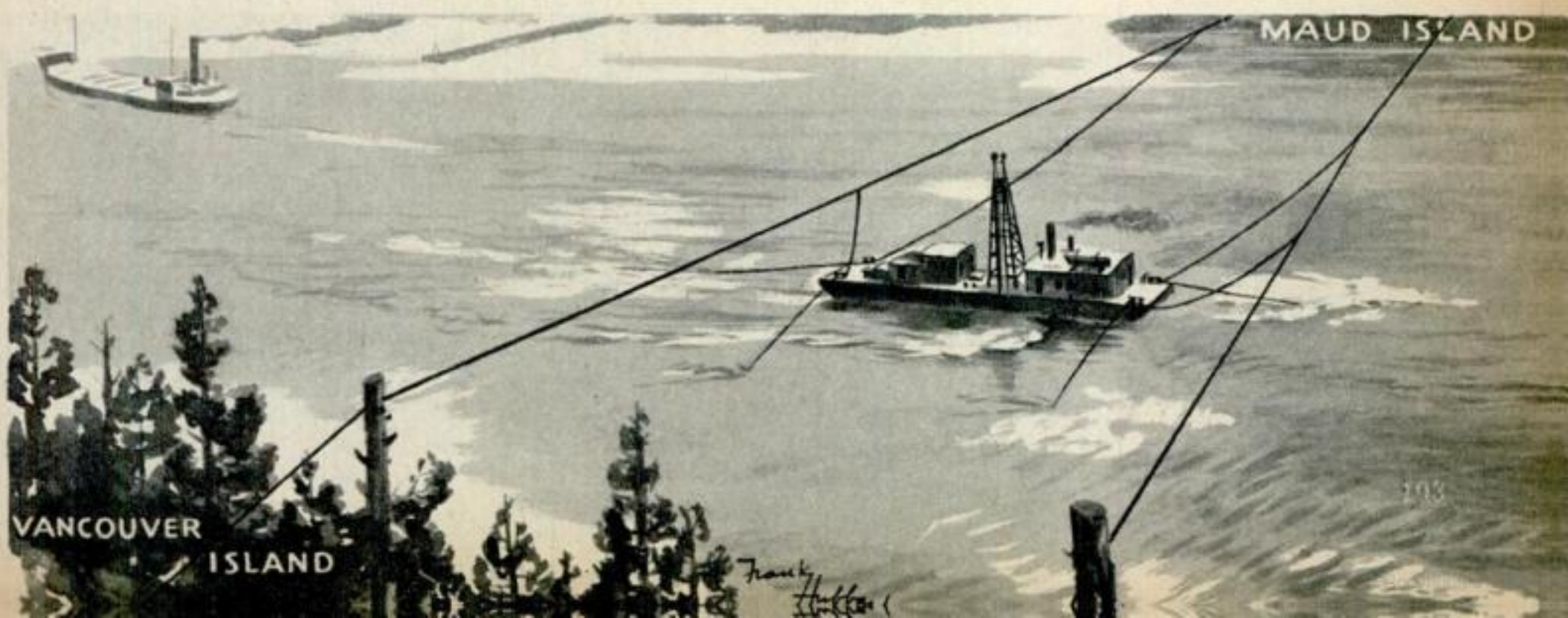
4 CONCRETE ANCHORS, four weighing 75 tons and two 125 tons, were molded in the spring of 1943. Hauled into position on specially built scows and dumped over the sides, they were designed to maintain the \$160,000 barge and its 80-foot drill tower in the raging current. Lines from the smaller anchors were made of $1\frac{1}{4}$ -inch steel cable, while the 125-tonners were attached to $1\frac{1}{2}$ -inch cables.



5 DRILLING got under way after the barge, anchored by the 550 tons of concrete, maneuvered to a spot above the rock. But the swirling waters proved too tough for the heavy lines.

6 CABLES SNAPPED, the first inside of 24 hours, 11 more within the next five months. Each time a cable broke, its anchor was lost and had to be replaced. A new method had to be found.

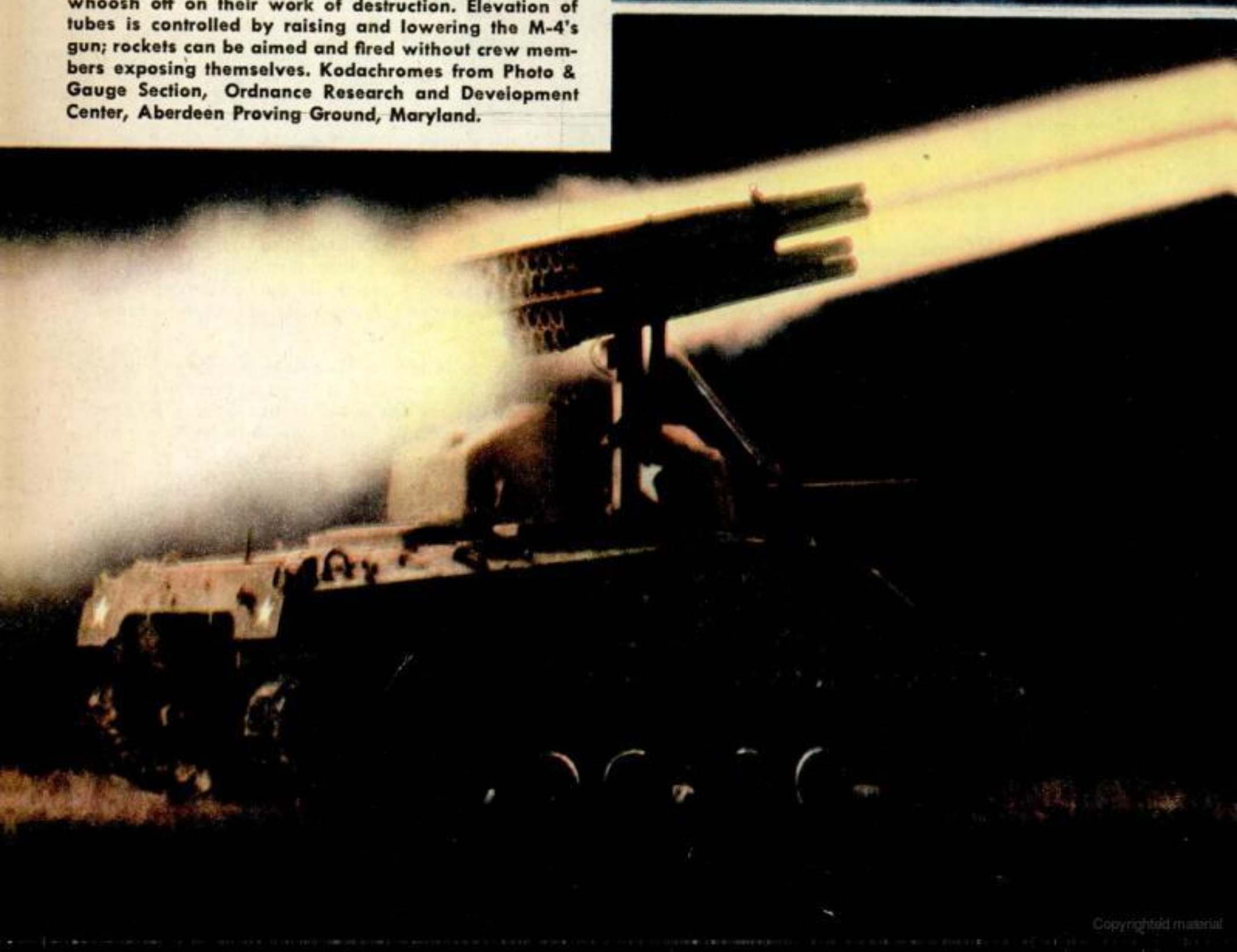
7 GIANT FIR TREES are now used to hold the drilling barge in place. Two lines of $1\frac{3}{4}$ -inch cable span the channel 325 feet above the water. Lines extend downward from these to the ends of the barge. At water level, two more lines stretch from shore to vessel on one side. If this unique hitching plan works, 354 holes will be drilled in the 175 by 250-foot rock to blast it 30 feet below the high-tide mark.





The "Calliope" Plays

Here's how our 60-tube, tank-mounted rocket launcher looks by day and by night as its 4.5-inch projectiles whoosh off on their work of destruction. Elevation of tubes is controlled by raising and lowering the M-4's gun; rockets can be aimed and fired without crew members exposing themselves. Kodachromes from Photo & Gauge Section, Ordnance Research and Development Center, Aberdeen Proving Ground, Maryland.





*What Do You Know
About Thermostats?*

The housewife sets an indicator on this electric stove, but it is sensitive thermostats that control burner and oven heat.

Our Watchdogs of Heat and Power

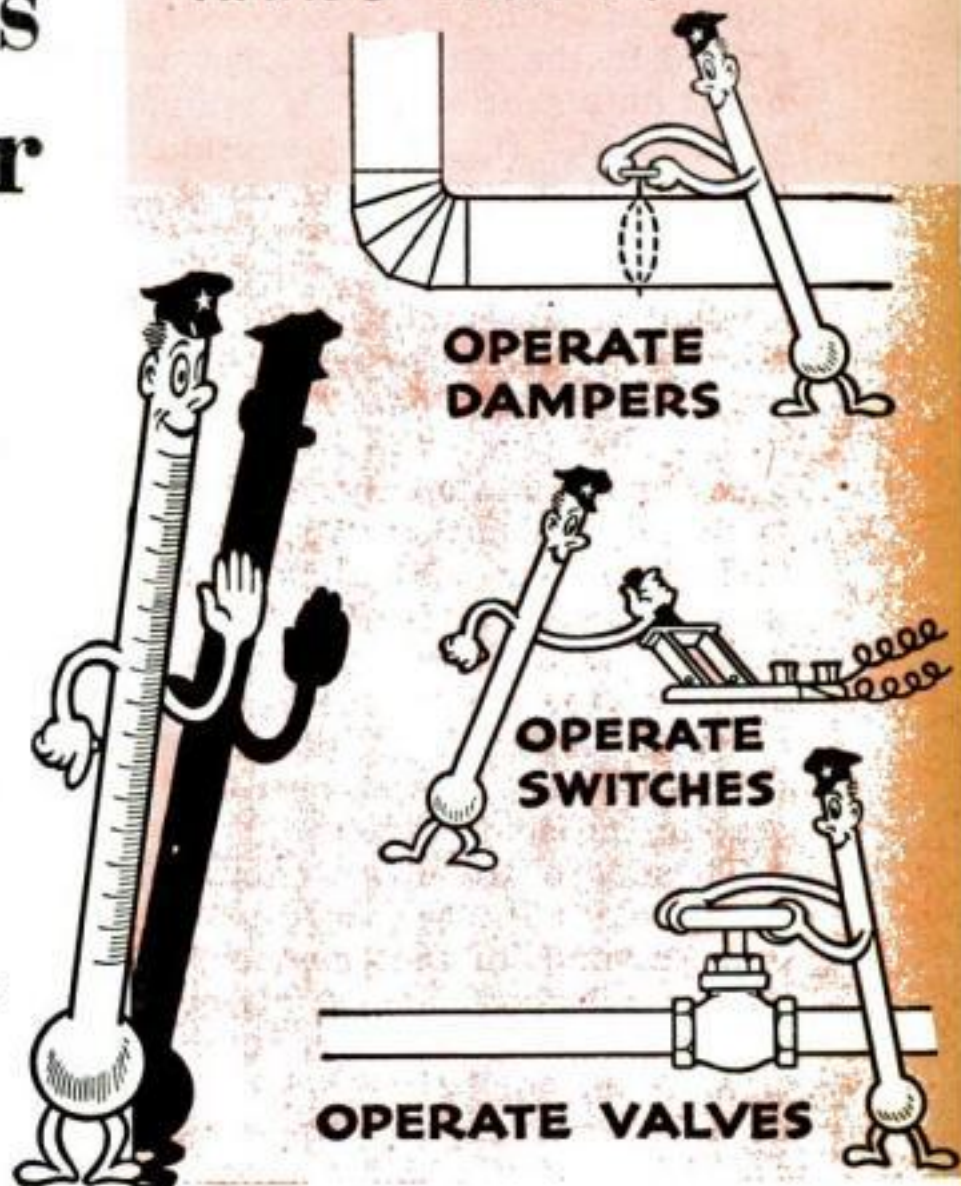
By GOLD V. SANDERS

THOUGH you may be entirely unconscious of the fact, there are thousands of thermostats working for you right now, making your daily life more comfortable. The more we go in for automatic living, the more we depend upon these small instruments that are so efficient and yet so simple.

Everything from heating pads to Superfortresses depends upon thermostats for smooth and dependable operation. The B-29 has over 350 of them to keep its many small motors and vital instruments functioning in temperatures that may change from 70 below zero to 100 above in a matter of minutes.

Your electric refrigerator would not be worth having without the thermostatic control that weighs a few ounces and turns the motor on and off to maintain the proper temperature. Mechanized warfare would not be

THE THERMOSTAT IS A
THERMOMETER WITH
HANDS THAT . . .



WHAT DO YOU KNOW ABOUT THERMOSTATS? (Continued)

possible without thermostats. Practically every piece of ordnance owes its efficiency to one or more of them. Your automobile has more of them than you probably suspect.

If you have an ordinary room thermostat, you don't have to go down to the basement to regulate the furnace. The thermostat behind that small case on the wall figuratively goes downstairs for you as often as necessary, turning the fire up or down, keeping an even temperature in the living quarters, and doing it far more accurately than you could. This efficient chore boy is yours for life at a cost of about six dollars.

The housewife sets her oven to the proper temperature to bake a cake. The thermostat is what she adjusts when she sets the dial. By this easy method she gives the thermostat her command, and from then on it will carefully turn on the gas, oil, or electricity as needed and accurately turn it down to keep the oven from getting too hot.

While her cake is baking, the housewife may do some ironing with a modern electric iron which also is held at the right heat for different kinds of fabrics by a thermostat about the size of a silver dollar. Such an iron will not overheat if left alone.

The waffle iron flashes a light, a signal given by the internal thermostat, telling us that the waffle is done to the color selected and that the current has now been turned off. The automatic toaster is controlled in the same way. The water tank needs no attention if it is equipped with a thermostat. It always contains a given amount of hot water.

In your car, the automatic choke is actuated by a thermostat that graduates the amount of air admitted to the carburetor from a cold start to a full warm-up. Another thermostat holds the water stationary around the cylinders so that the engine warms up quickly, then opens a valve to permit circulation. The cigarette lighter inside the car that clicks out when the heating element is red hot owes its clever action to a simple bimetallic disk that snaps at the right time and turns off the current. Perhaps the latest of everyday things to come under control of a thermostat is the soldering iron.

These are the most common tasks of thermostats, those nearest to us in our daily habits. In factories, of course, they do an endless variety of intricate and vital jobs without which modern mass production would not be possible. War weapons of all kinds depend upon their simple, positive action. Many of these thermo-

THREE MAIN TYPES



ELECTRIC IRON, ROOM THERMOSTAT. In the iron, a little metal disk clicks to make or break the circuit. In the room thermostat, a coil moves to regulate heat supplied by the furnace.



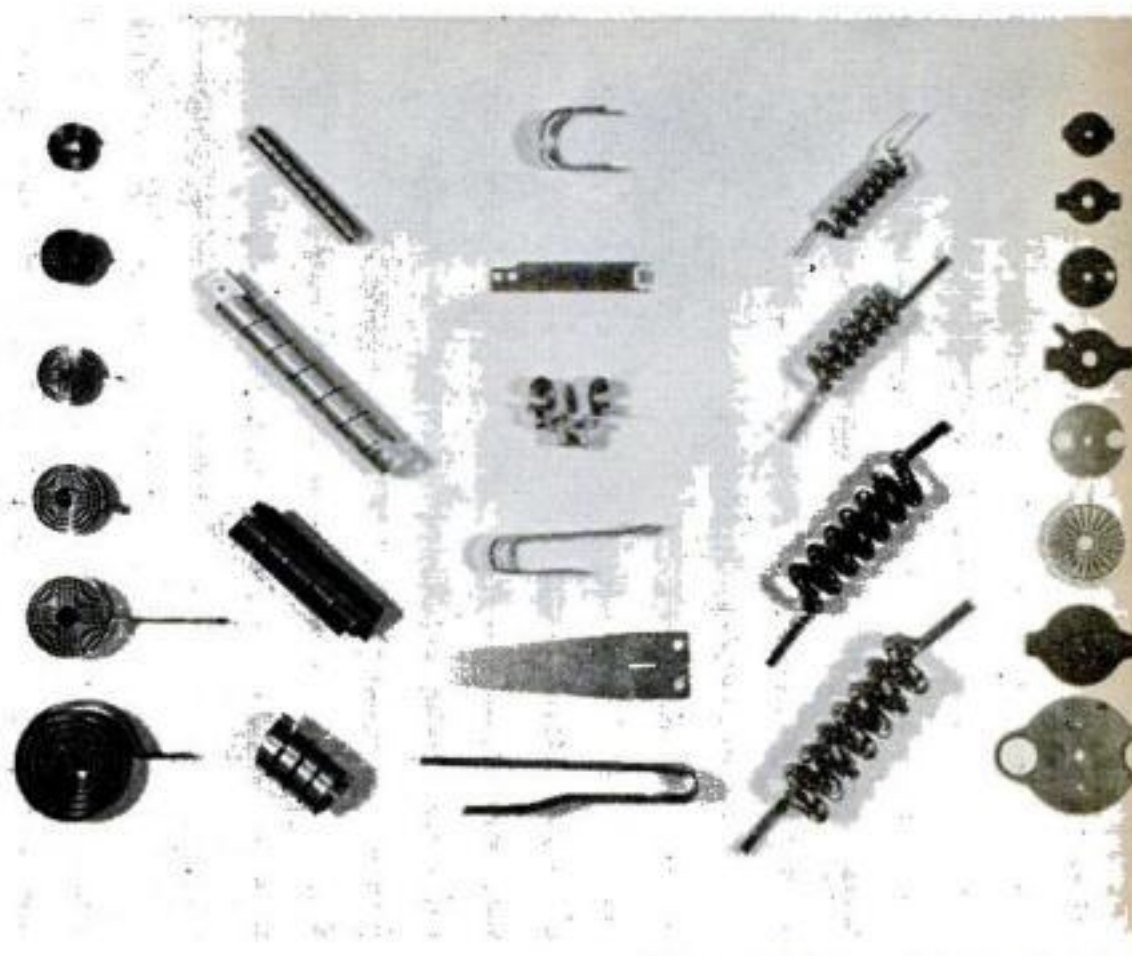
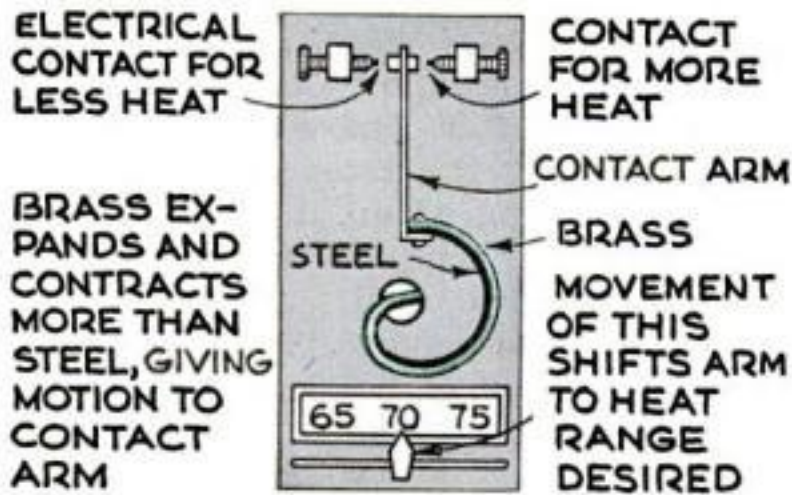
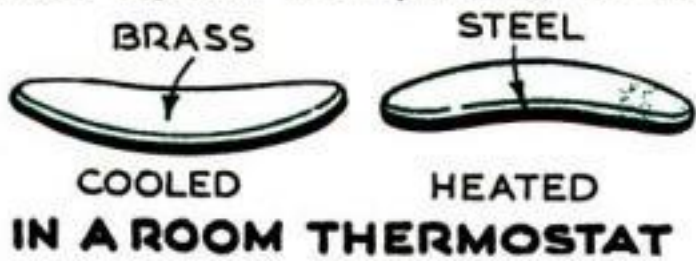
GAS RANGE oven heat is governed by the brass-tube type. When temperature reaches the dial setting, the flame is lowered for even heat.

ELECTRIC REFRIGERATOR cooling unit is operated by a motor controlled by bellows. Current comes on when expanding bellows joins contacts.



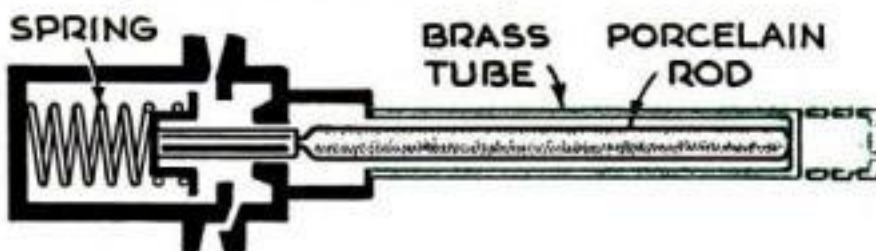
OF THERMOSTATS, AND HOW THEY DO THEIR JOBS

BIMETALLIC TYPE. Thermostats of this kind depend upon the variation in expansion of two metals (usually brass and steel) joined together in strips, coils, or disks.



(Spencer Thermostat Co. photo)

BRASS-TUBE TYPE. The difference in the expansion rate between a porcelain rod (or one of carbon) and the brass tube provides the action.



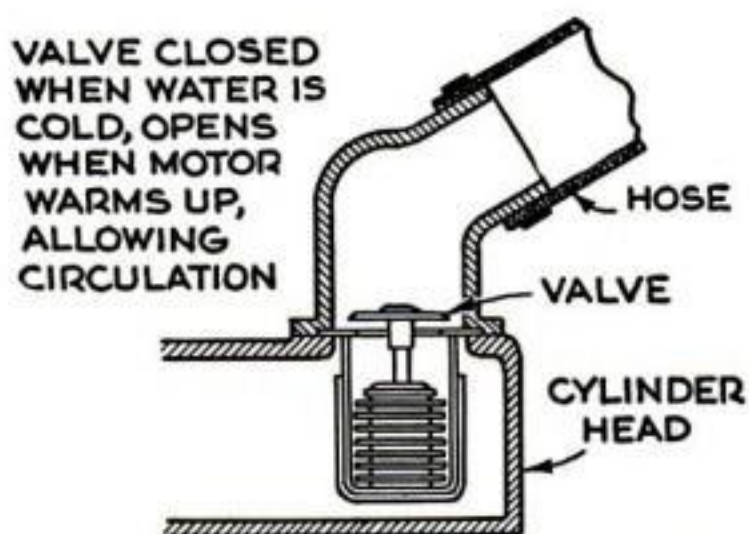
BRASS TUBE CONTRACTS WHEN COOLED, FORCING PORCELAIN ROD TO LEFT, OPENING VALVE. HEAT EXPANDS TUBE, PERMITTING ROD TO MOVE TO RIGHT. SPRING CLOSSES VALVE

ELEMENTS for bimetallic-type thermostats may take the form of coils (two left columns), simple strips (middle column), springlike spirals (fourth column), or disks. In each case, different expansion rates of component metals produce movement.

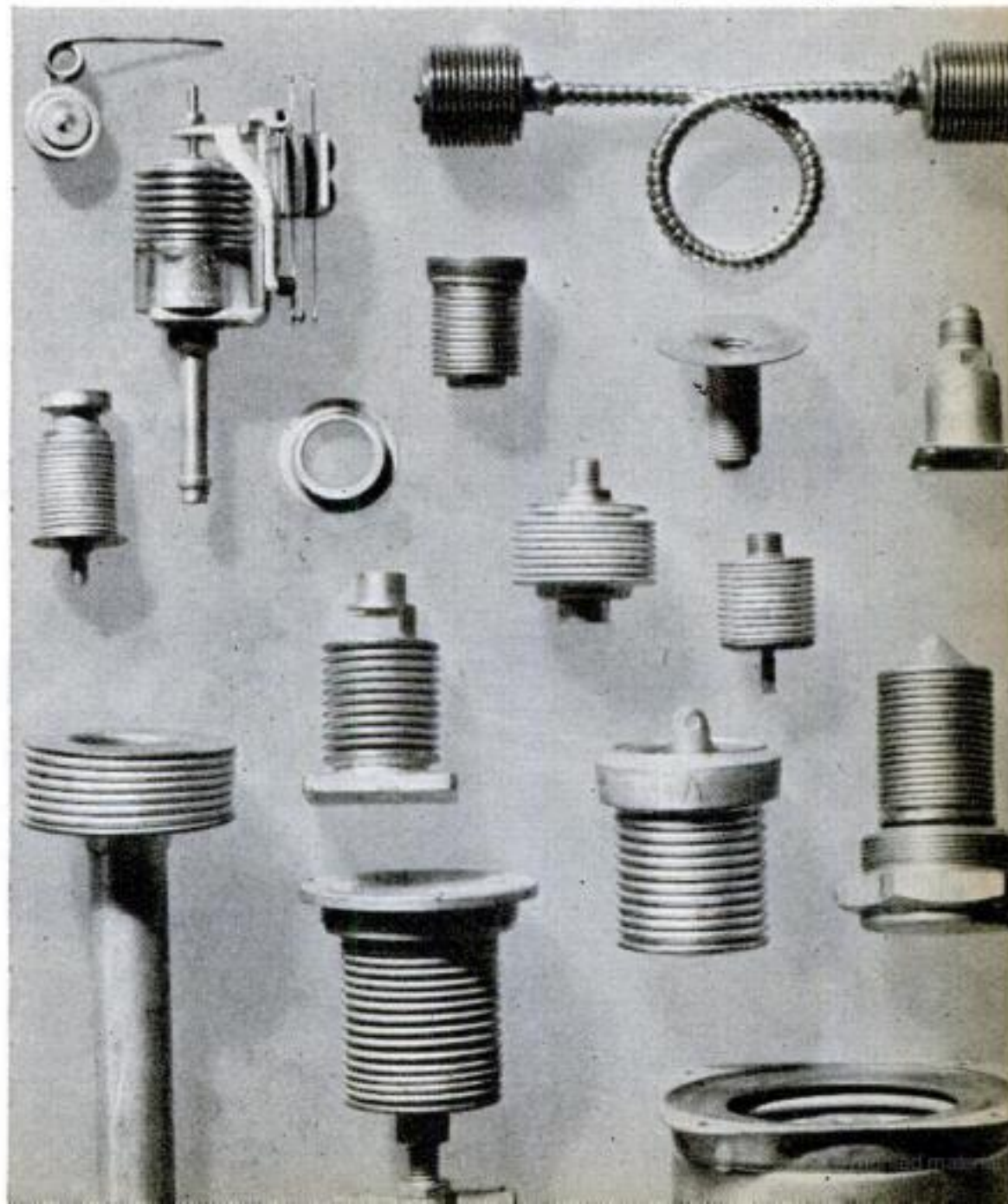
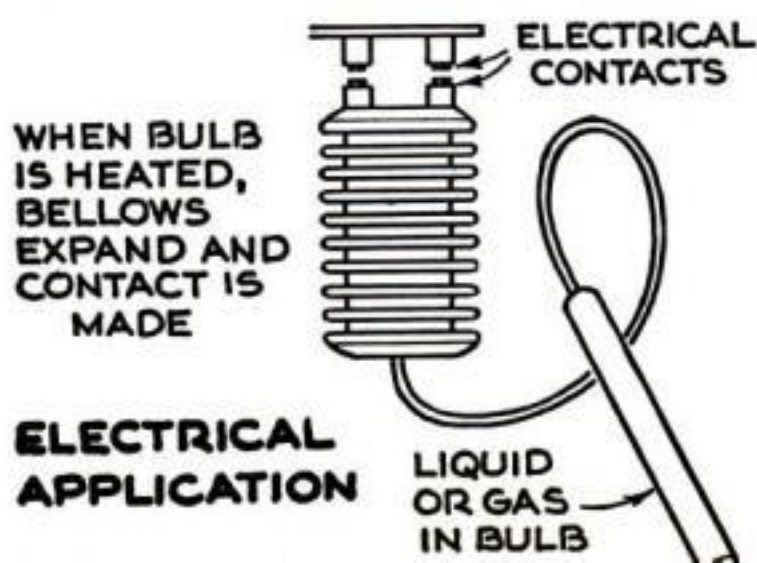
METAL BELLOWS for thermostats are specially designed to hold various types of liquids or vapors. The bellows itself may be a valve, expanding as water inside it is heated. Or it may be inflated from pressure tubed from a liquid or gas-filled bulb.

(Photo by Fulton Sylphon Co.)

BELLOWS TYPE. These get their action from expansion and contraction of flexible metal bellows, using a liquid or a vapor to provide the necessary pressure.



IN WATER JACKET OF CAR



WHAT DO YOU KNOW ABOUT THERMOSTATS? (Continued)

stats are of the circuit-breaker type and guard the myriad small motors in mechanized equipment from overheating and overloading. They also keep the oil at the proper temperature in hydraulic gun mounts.

Since we depend so much upon thermostats, perhaps it would be interesting to know more about what takes place behind the dials that we adjust to do our bidding. A thermostat is actually a very simple instrument. It works by taking advantage of the expansion caused by heat—the expansion of either metal, liquid, or vapor. Any thermostat is essentially a thermometer, but whereas a thermometer only tells what the temperature is, the thermostat does something about it. The thermostat determines what the temperature range shall be within the area assigned to it.

One of the most common types is that actuated by a bimetallic strip, coil, or disk. In all these units, one side of the metal element is of a metal having a high coefficient of expansion, such as brass, the other side of a steel alloy or some other metal which expands little under the influence of heat. The different rates of expansion of the two sides give an accurate gauge of the temperature and at the same time a mechanical force to open and close valves or electric circuits.

Another common type gets its action from expansion and contraction of flexible metal bellows containing various types of liquids or vapors for different kinds of jobs. In your electric refrigerator, for instance, this liquid may be one that boils at a low temperature. This creates vapor pressure which causes the bellows to expand and close the circuit to the motor.

Still another type in wide use employs a brass tube containing a rod of carbon or porcelain, the differential in expansion rate between the tube and rod giving the necessary action.

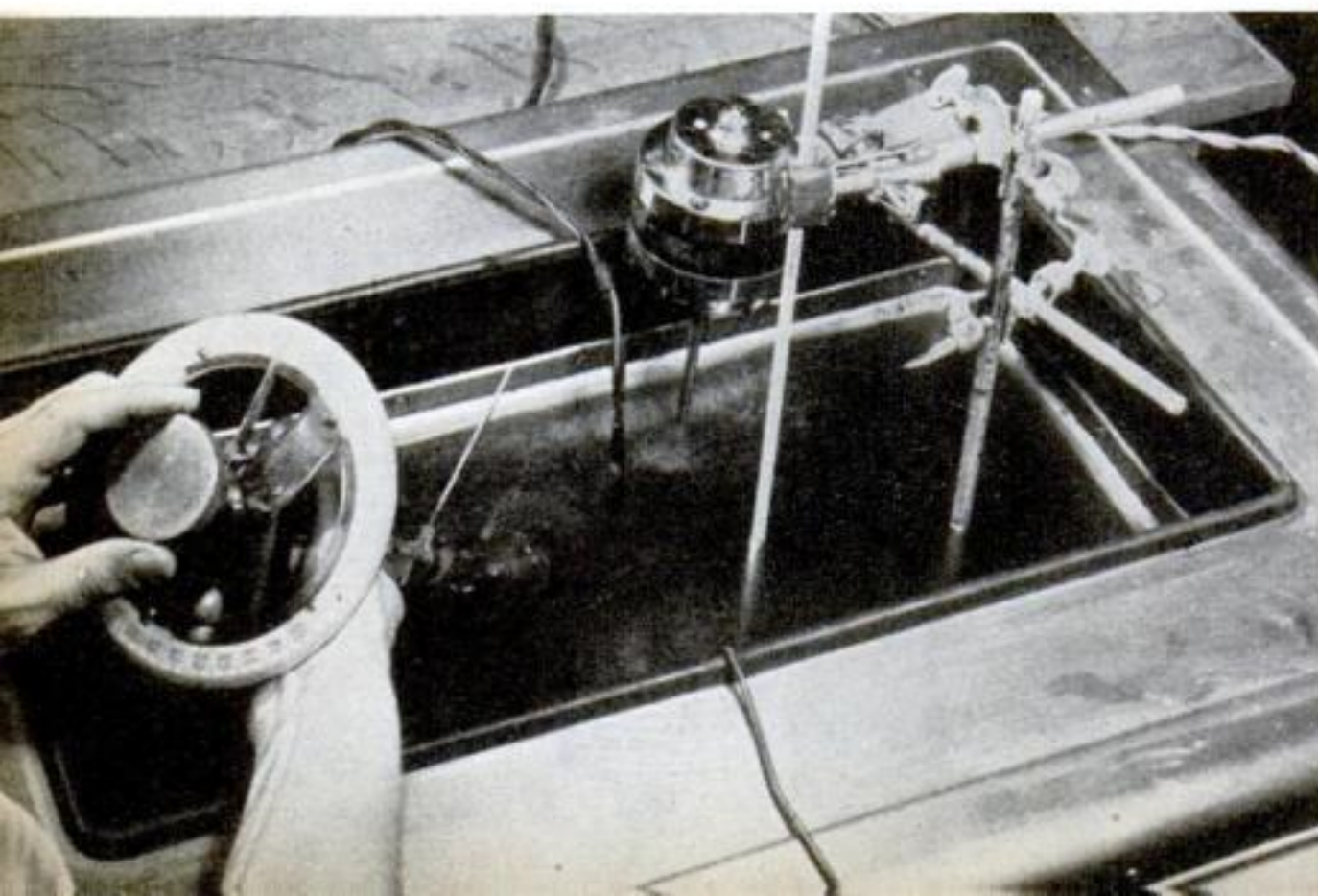
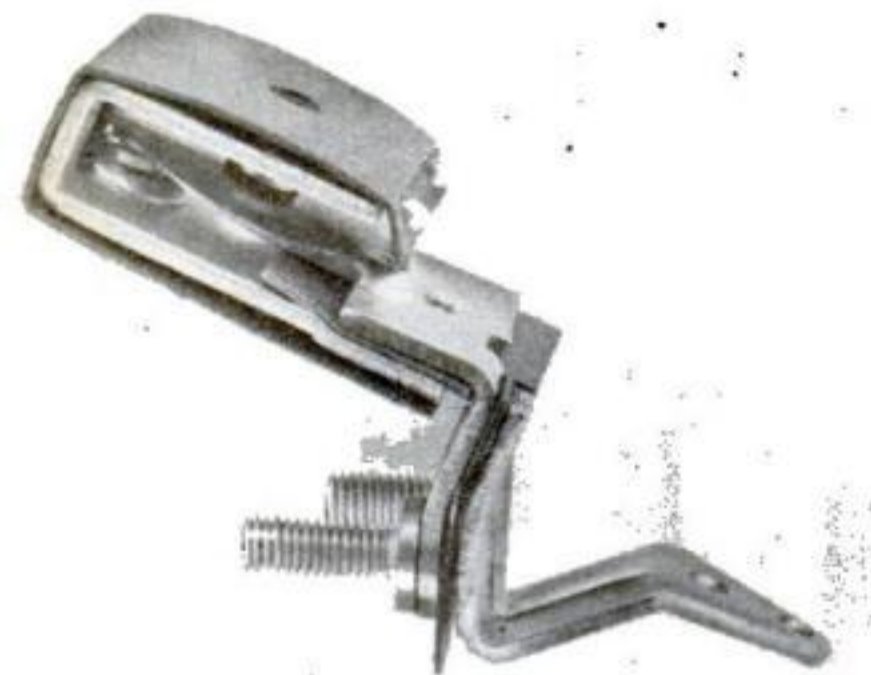
For highly critical regulation, as in some factory processes, a thermocouple is employed as the heat-measuring agency. In these highly accurate instruments the differential in expansion between two metals sets up an electromotive force, and the change of this force is measured. In a series of thermocouples,

[*\(Continued on page 190\)*](#)



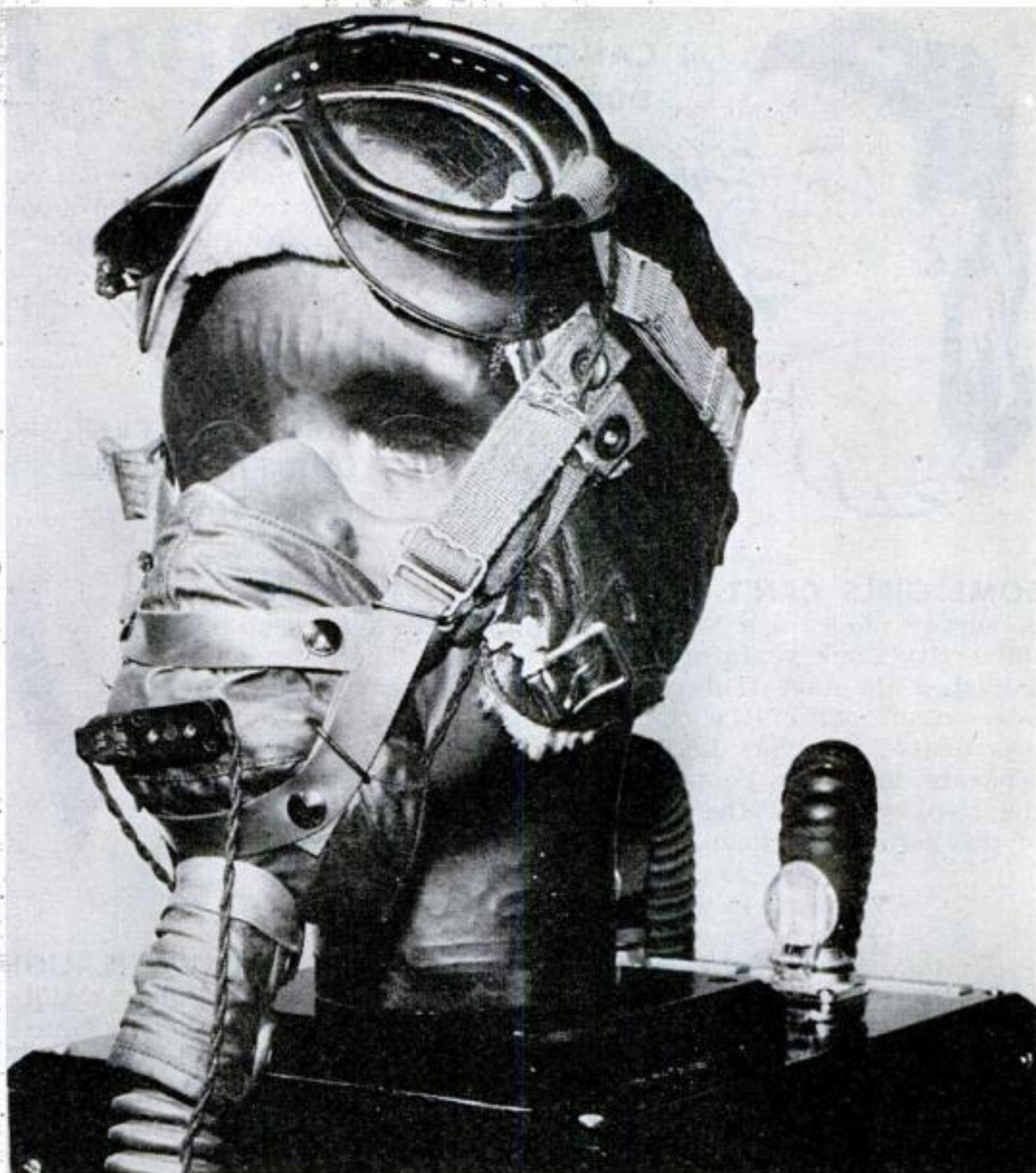
FIRST THERMOSTAT. This unit could be set to cooler or warmer, not to degree of heat.

BIMETALLIC DISK actuates a circuit-breaker thermostat (below), a type employed in vehicles.



HOT OIL is used to test bimetallic thermostats whose field of control is to be from 212 to 350 degrees Fahrenheit. A unit is dunked and the microscale indicator held by the workman shows how it responds. Instruments designed for use up to 212 degrees are checked in water; those for extremely high temperatures in lava. For thermostats to be used below the freezing point, a silicate solution is the testing medium.

(Photo by Spencer Thermostat Co.)



Ready for a theoretical trip to the substratosphere in an ice chamber, the breathing robot wears a flyer's mask fitted with an electric warming jacket that keeps frozen moisture from clogging the air ports

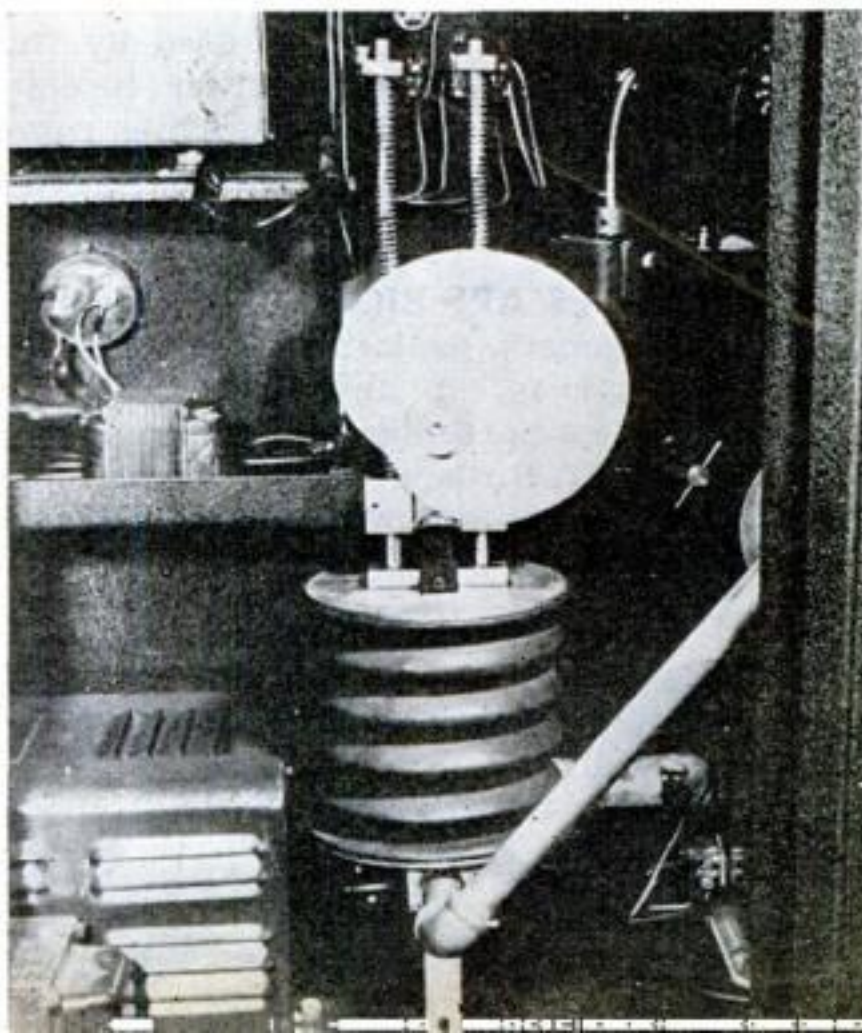
“Breathing Head” Tests Masks

WITH its head in an ice chamber and its lungs in a box outside, a robot works overtime at Wright Field to save the lives of high-flying bomber crews. Its job is to test oxygen masks under high-altitude conditions, replacing human guinea pigs.

Every factor in human respiration can be reproduced by the “breathing head” and its connected apparatus. Temperature and humidity of breath are duplicated. Even the rubber skin is warmed to the temperature of human skin in substratosphere cold.

Already the head has helped Aero-Medical Laboratories to devise an electric warming jacket, worn over the mask, that keeps the breath from freezing and clogging the breathing ports. General Electric made the robot head and the warming jacket.

LUNGS of the robot are a bellows, worked by a heart-shaped cam that gives a natural pause.





**I CAN TOO
DO IT. SEE?**

ODD FACTS

"DON'T believe anything you hear, and only half of what you see" comes fairly close to being good advice. The Better Vision Institute has gone into the subject of seeing with great thoroughness, and many of its findings help us to understand what

**I HELP LIGHTEN
YOUR FINANCIAL
PROBLEM!**



SOME GIRLS CAN'T WINK.

A survey made in a Western university some years ago established the fact that about one out of four of the co-eds was unable to wink. Lack of separate muscular control of the two eyelids is the cause of this serious handicap.

MONEY HAS EYES. Ever notice this symbol on a dollar bill? The pyramid with an eye is from the Great Seal of the United States, where it represents the many interventions of Providence in behalf of the American cause.



**KEEPS THE
DUST OUT OF
MY EYES!**

BEEES USE AN EYE BRUSH. Every honeybee carries a brush for regular use in cleaning its eyes. The brush is a tuft of bristles on the outside of the leg, and is used by the bee for removing pollen or other foreign matter that he has picked up while rummaging around among the flowers.

WHALE'S EYES ARE BIGGEST. Some species have peepers as large as grapefruit. An ostrich's eyes top any land creature's for size, while a horse has the largest of any land mammal. Birds generally have huge eyes. Those of some hawks and owls are as large as humans'.

HOW HEAVY IS LIGHT?

You could carry about all you've ever seen in your vest pocket. Light coming from a 10-hp. searchlight for 100 years would weigh less than one hundredth of an ounce—a bit more than four grains.



**IT FEELS
LIGHT TO ME!**

**I KEEP COOL
THIS WAY, AND
NO WATERTAX!**



ABOUT EYES

we see with our own eyes and what other animals see with theirs. One of the many valuable results of this scientific research has been improved eye comfort and greater efficiency for the workers in war plants and business offices.



EYES ARE CAMERAS. The image on the retina of the eye, just as in a camera, is always upside down. The brain, however, interprets it right side up. There have been cases where the brain has not worked normally in this respect, so that the victim has had to live in a world that was literally topsy-turvy.



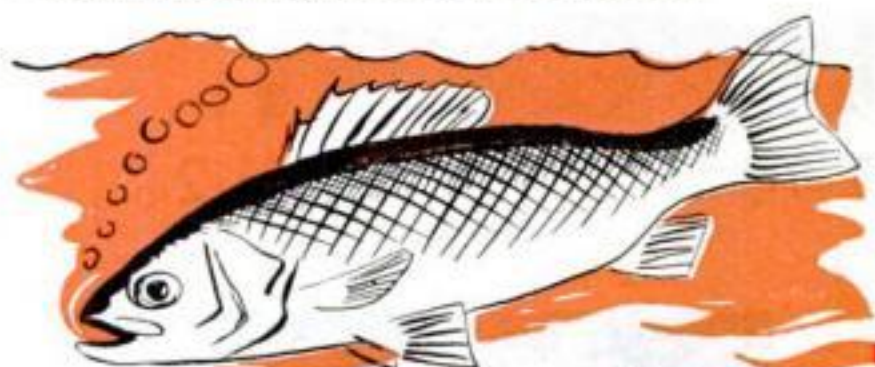
GRUESOME, AIN'T I?

THE SPIDER SEES A LOT. It's practically impossible to creep up on him unperceived, for most spiders have eight eyes grouped symmetrically around the sides of the head. All spiders have eight legs, but the number of the eyes varies from two to eight. Spiders have two types of eyes: nocturnal, especially suited for seeing at night, and diurnal for use during the daylight hours. As a rule, the color of a spider's eyes is either red or green.



NICE HON. PUSSY, COME HERE, PLEASE!

EVER SWALLOW AN EYEBALL? In some parts of China it is believed that the eyeballs of animals swallowed whole will improve human vision. If they are from nocturnal animals, so much the better.

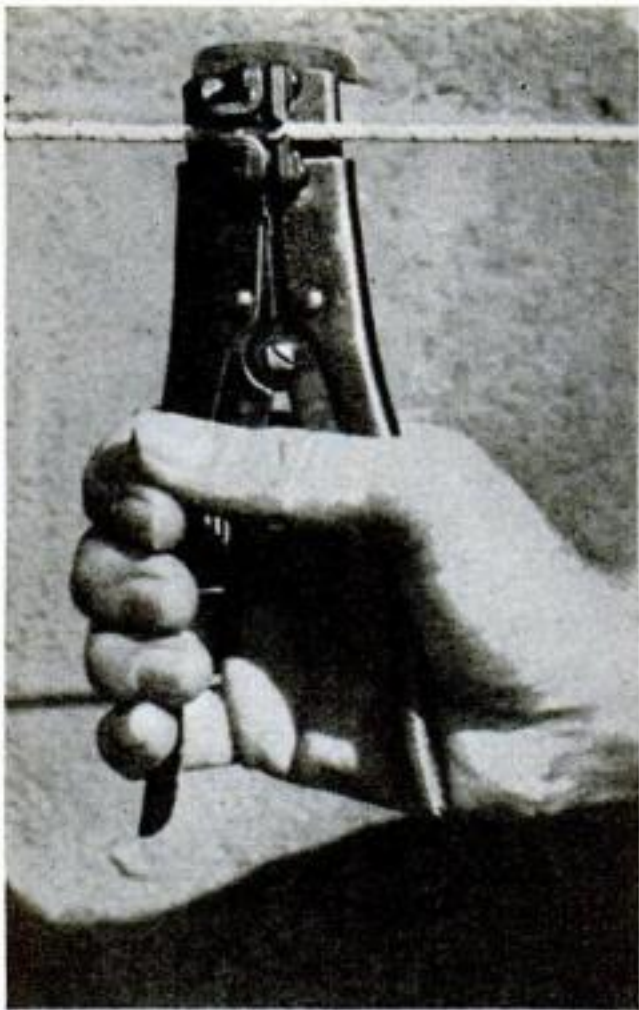


O. K., SO I'M A POOR FISH!

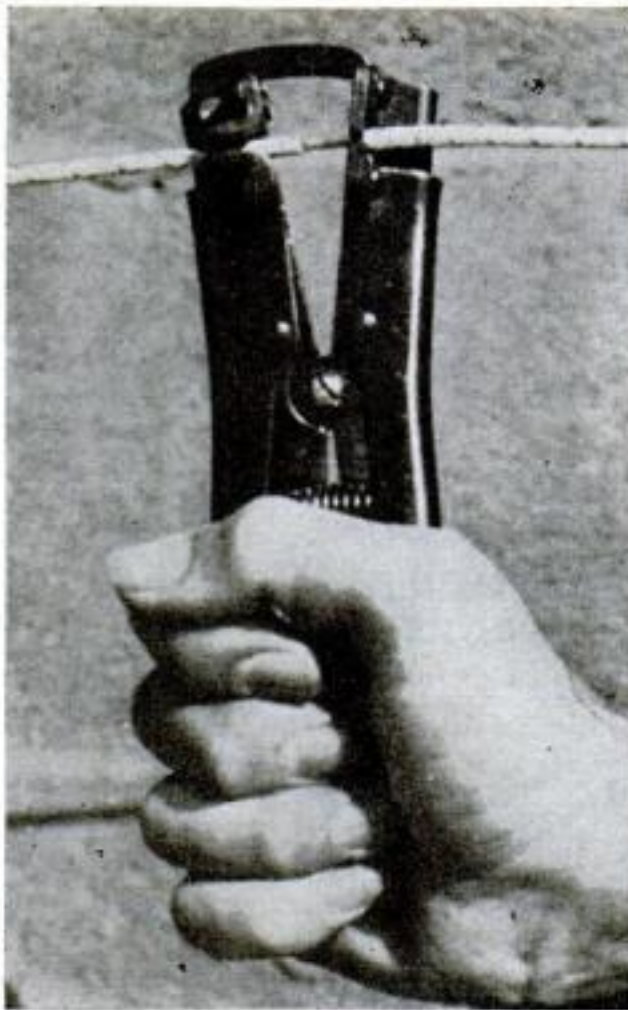
FISH GETS NO SHUT-EYE. The poor fish can't get his 40 winks because he has no eyelids. The eye surface keeps moist, however, for obvious reasons. Fish-eye lenses are round, and do not contract like the human-eye lens. Muscles pull them backward and forward to change focus.

MOVIES DON'T MOVE, but because it takes about a fortieth of a second for a picture to fade from the retina, each individual picture projected on the screen blends into the next one and thus creates the impression of motion.





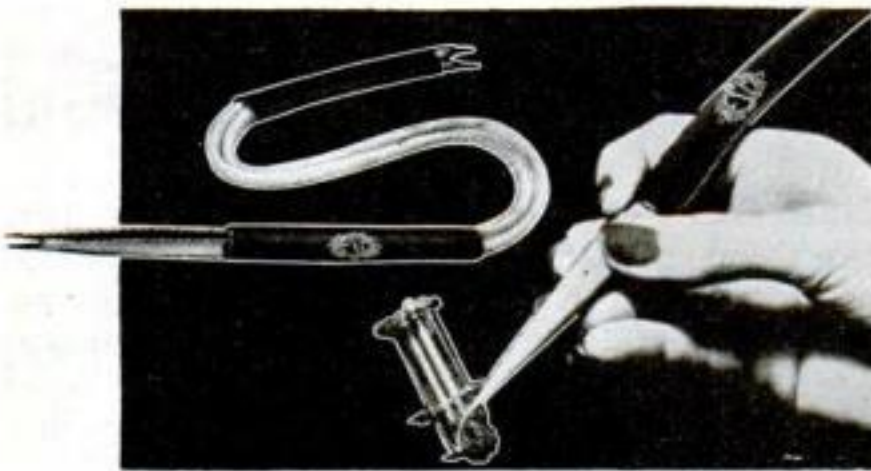
1 Toothed jaw at left grips wire; cutter at right nips insulation.



2 Further pressure strips the wire. Dog holds jaws apart for splice.

new Tools

A WIRE STRIPPER that works in tight places is proving useful to the Army Air Forces, especially for quick electrical repairs on bombers in combat. Adjustable for five gauges of wire, it nips through the insulation, strips it back about 1½ inches, and holds it there while the splice is made. When the tool is removed, the insulation springs back into place.

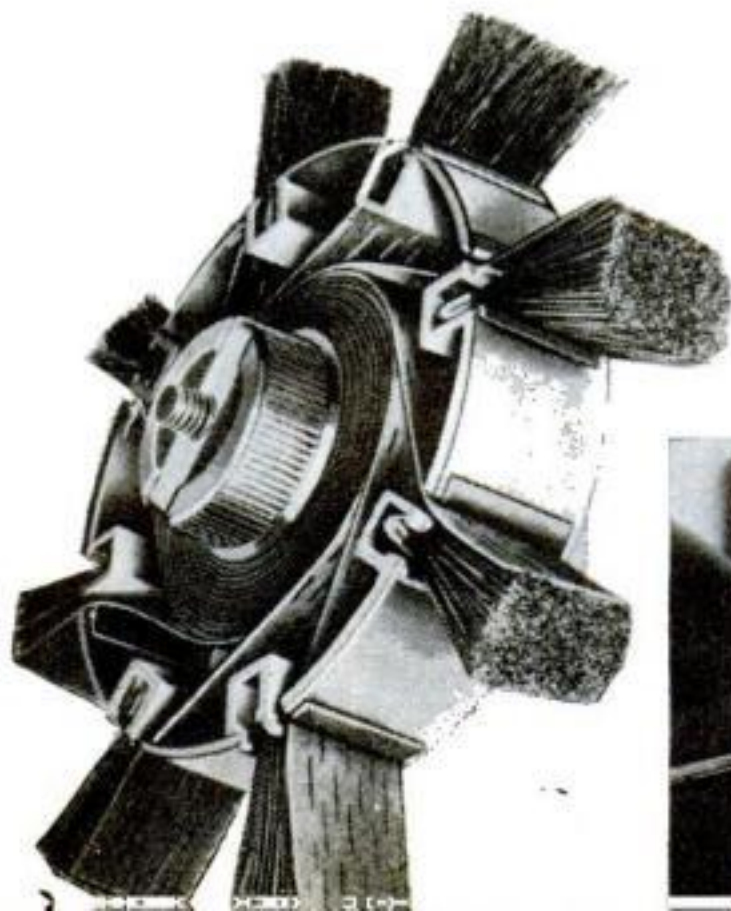


FILE CHIP PLOW. A small square of soft metal attached to a regular file cleaner removes chips of lead, aluminum, and other soft metals from between the teeth of a file.

Made by the Cincinnati Tool Co., the plow has four edges for use with files of different tooth patterns.



WELDING TWEEZERS developed for spot-welding radio-tube wires are handy for work on any small parts in hard-to-get-at places. Parts to be joined are pressed together and current is turned on. Made by New Jersey Jewelers' Supply, Newark.

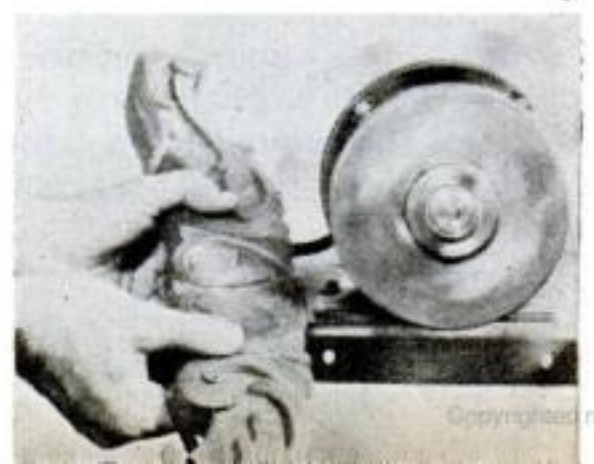


BRUSH-TYPE SANDER that can be fitted to most motor shafts is adapted to finishing automobiles, furniture, and models, or other jobs involving all types of materials. It is effective on irregular surfaces, and can be loaded with the correct abrasive for any job. Makers are Exactone Tool & Die Co., Hollywood, Calif.

ON A CAR



IN THE SHOP





Japs Gamble on "Human Bombs"

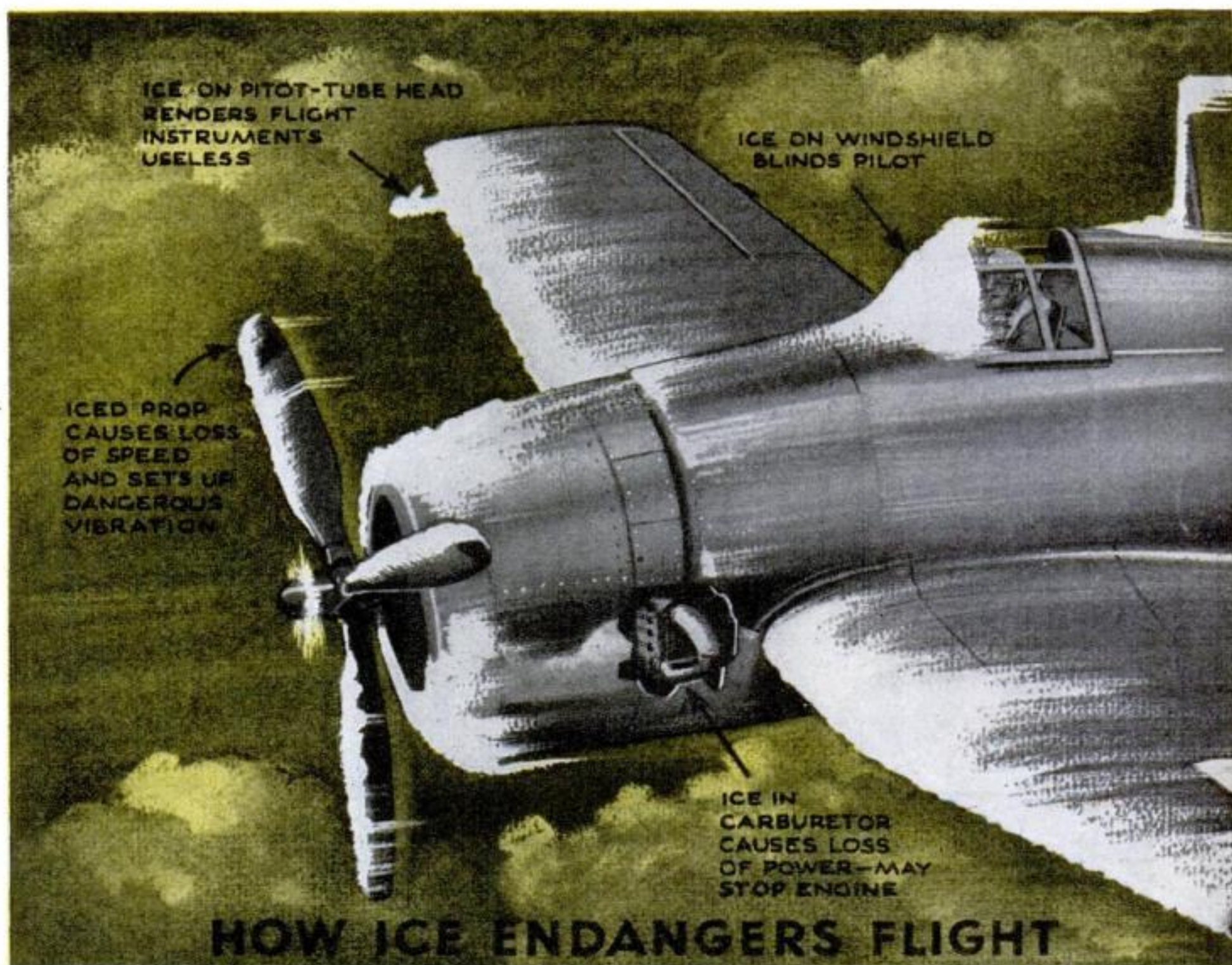
JAP "Baka bombs" hurled at U.S. invaders of Okinawa are now revealed as a desperate application of suicide tactics to a weapon resembling the Nazi V-1 and V-2 robots. In the drawing above, artist Stewart Rouse gives his conception of one type of "human bomb," based on details from reports of American observers.

This "Baka" is a small, rocket-propelled plane with a wing span of about 16 feet and a length of more than 19 feet. Carried

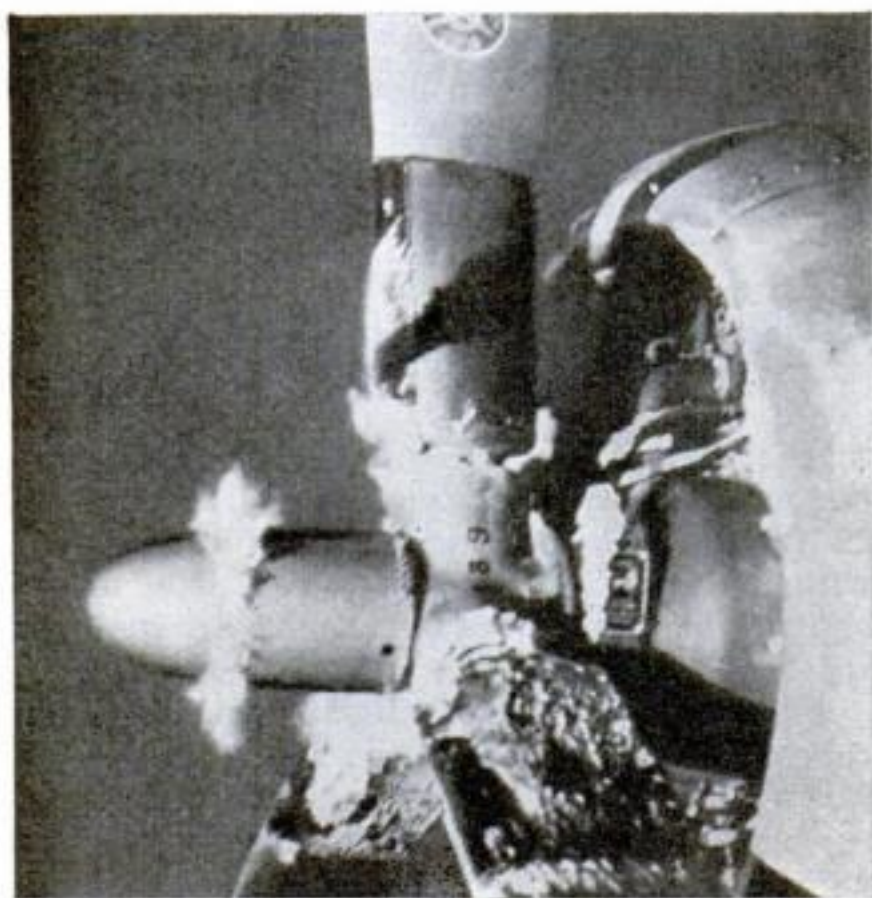
to the scene of action under the belly of a larger plane, it is launched and guided at its target by a suicide flyer. If its nose or wing strikes any solid object, the heavy charge of explosives in the war head is set off.

The death-devoted pilot wears a burial robe and a rising-sun head scarf containing farewell messages from his relatives. Scornful Americans supplied the name "Baka," which is Japanese for "Stupid."

How Planes Fight the



Ice got a choking grip on this B-17 propeller as it built up around the hub and onto the blades. Ice formation on a "prop" robs it of its thrust.

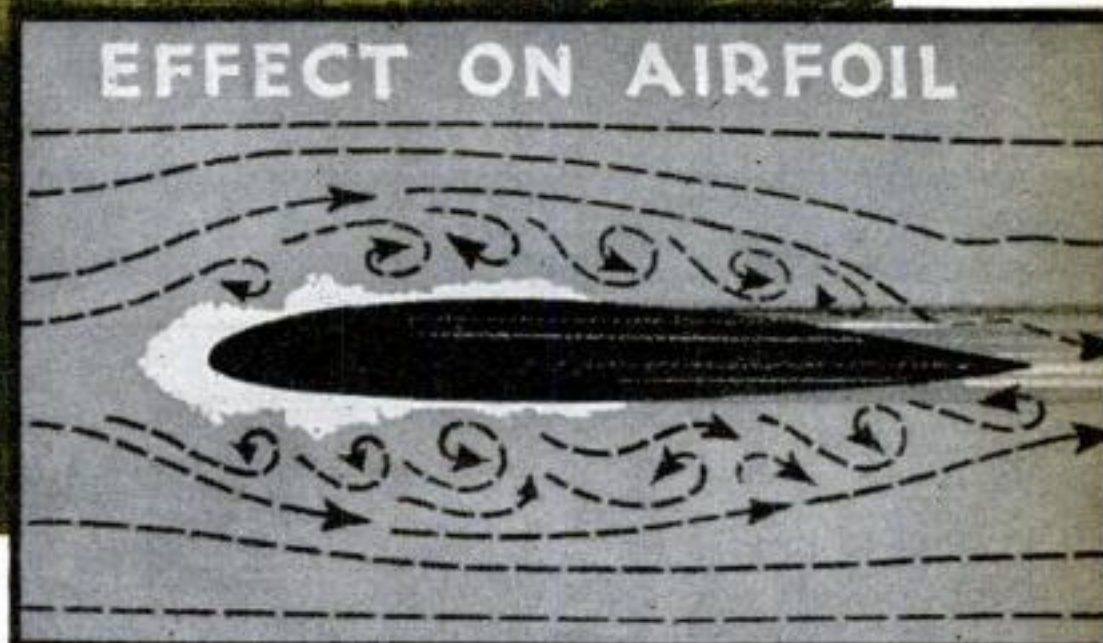


By **MAJ. JOHN C. HERBST**
and **MAJ. CARL T. SIGMAN**

THE day was bright and clear, the mercury a couple of degrees above freezing. Puddles of water dotted the airfield. The pilot taxied to the end of the runway and tried to swing his plane around—but by then it was vibrating badly from the accumulation of ice on the propeller and the ailerons were frozen tight. Taking off would have been fatal.

An ice-coated airplane flounders in the air like a swimmer wearing a heavy overcoat. On the ground or in the sky, a cumbersome burden of frozen moisture can be picked up in a few minutes, and even an invisible film of ice may drag a plane down if it is not quickly liquidated. Fortunately for everyone who must fly under ominous atmospheric conditions, however, many ways have been invented to give ice a hot-foot.

"White Devil" of the Air



The propeller blast from a plane on the ground may splash water from puddles onto the wing. This water was not frozen when it lay undisturbed, but is turned quickly from a liquid to a solid cloak when agitated and sprayed over a plane.

Icing during flight is usually heaviest at temperatures around 25 degrees Fahrenheit; it is less frequent below zero, and rare at temperatures lower than -30 degrees or altitudes greater than 25,000 feet. It is most likely when the moisture in the atmosphere is visible as mist, rain, or snow.

Turbulent frontal clouds contain large drops that form "glaze," the kind of clear ice that tinkles cheerfully in a glass. Rough and granular "rime" ice results from the smaller drops of water in stratus and fog. It resembles the accumulation on refrigerator coils, and the additional drag on an airplane from this kind of ice is greater than from feathery frost or glaze. But the ice formations on planes are rarely all rime or

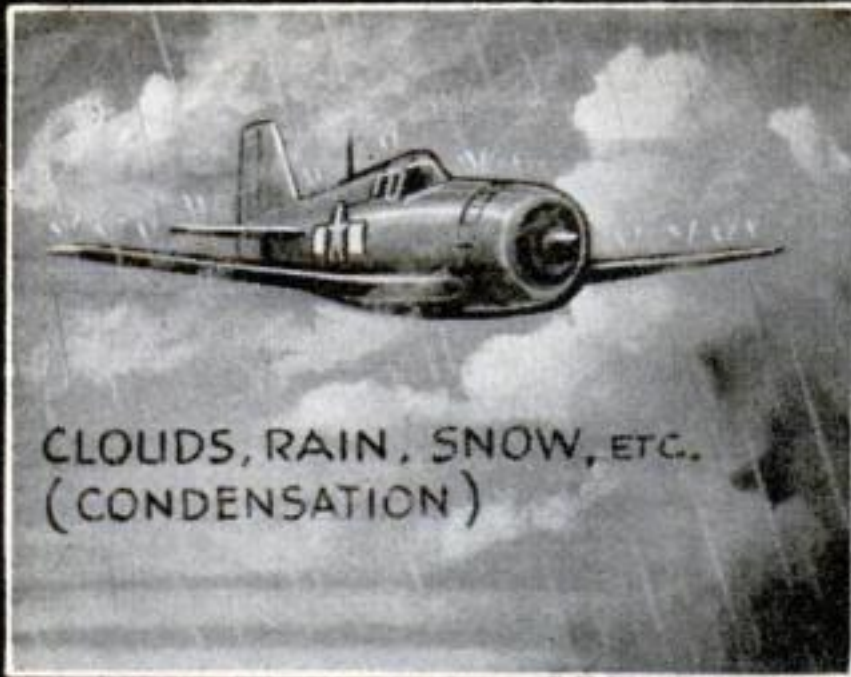
all clear; in most cases they are mixtures.

The wing is the most readily affected part of a plane. The airfoil, or cross-sectional shape, of every wing is carefully designed to permit a smooth flow of air around the wing surface. Ice builds up first on the leading edge, then creeps along the top and bottom. The wing thus acquires a strange, new, changing shape. The airfoil's efficiency is lost—and, at the same time, the load that the wing must support in flight is increased by the weight of the ice.

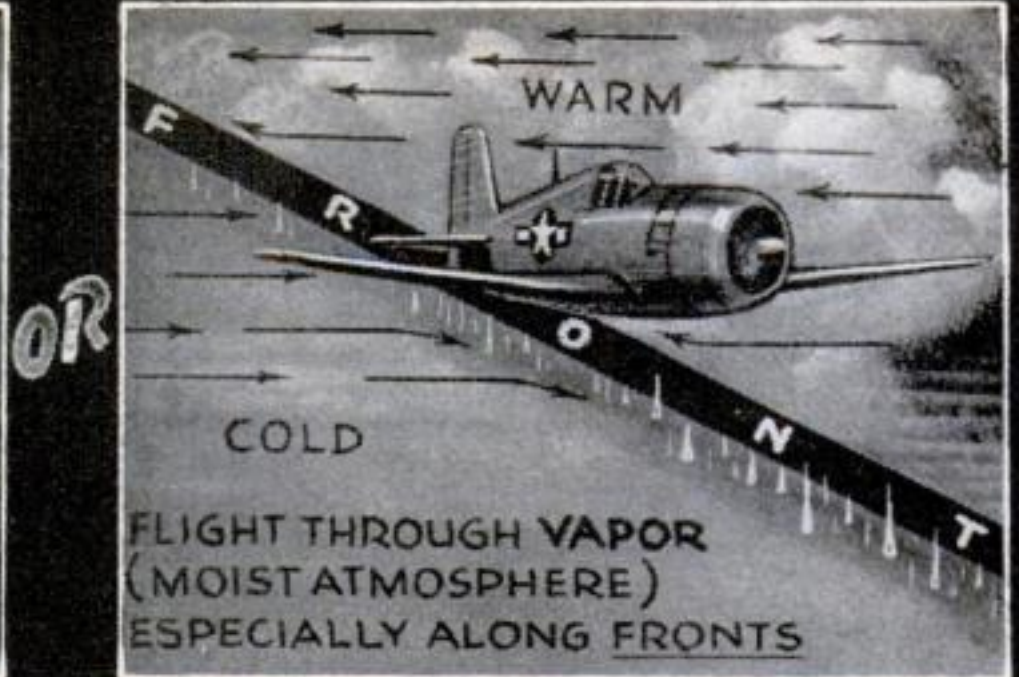
Rubber "overshoes" are the most familiar equipment for quickly dislodging ice from wing and tail surfaces. They are attached to the leading edges of the wing, fin, and stabilizer, and fit flush when not inflated. But there are manifolded cells within these de-icing shoes, into which air is fed periodically by an engine-driven vacuum pump. The cells are thus expanded in

THESE ARE THE CAUSES

VISIBLE MOISTURE



INVISIBLE MOISTURE



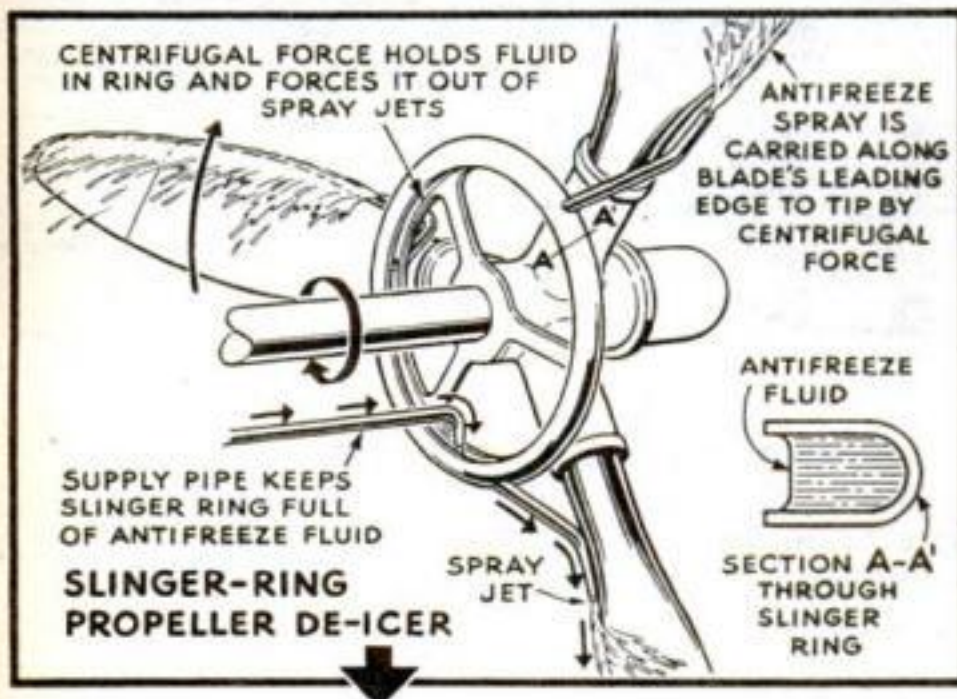
rotation, and this pulsating action cracks loose the thin ice sheets.

Unfortunately, these overshoes cannot shake off ice already built up on the top-side or undersurface. Another disadvantage is that the shoes act as spoilers, disturbing the flow of air over the wing. Hence, they cannot be used when taking off, flying at low speeds, or landing.

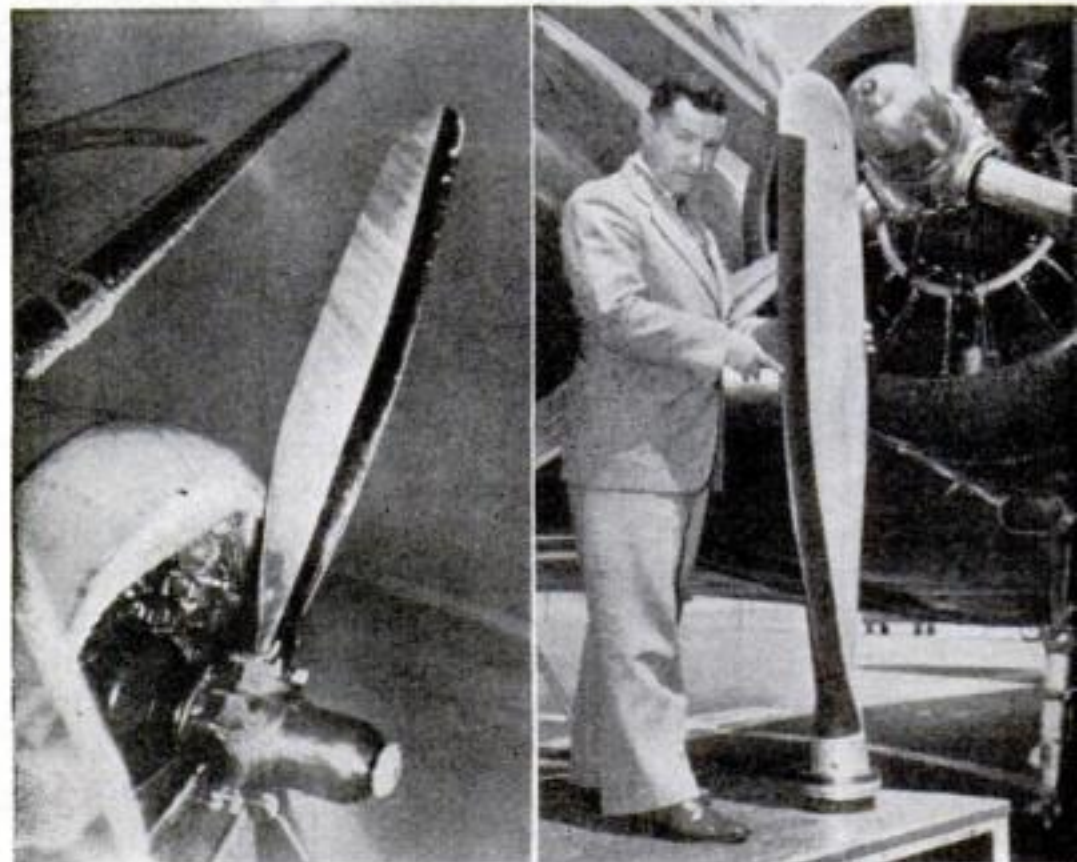
A more efficient way of forestalling icing

is the use of "hot wing" apparatus developed by the NACA and Consolidated Vultee Aircraft. This consists of a duct system, through which hot exhaust gases are piped from the engines to the wing and tail surfaces. No pump is required with this superheating device, because hot air is rammed through the ducts by the propeller blast when the plane is on the ground and by impact airflow when it is aloft.

WHEN ICE ATTACKS A PLANE IN FLIGHT,



... ON PROPELLERS



↑ **ELECTRICAL CURRENT** heating a middle layer of chemically treated synthetic rubber melts ice on a blade's leading edge. An inner layer insulates, outer layer is protector.

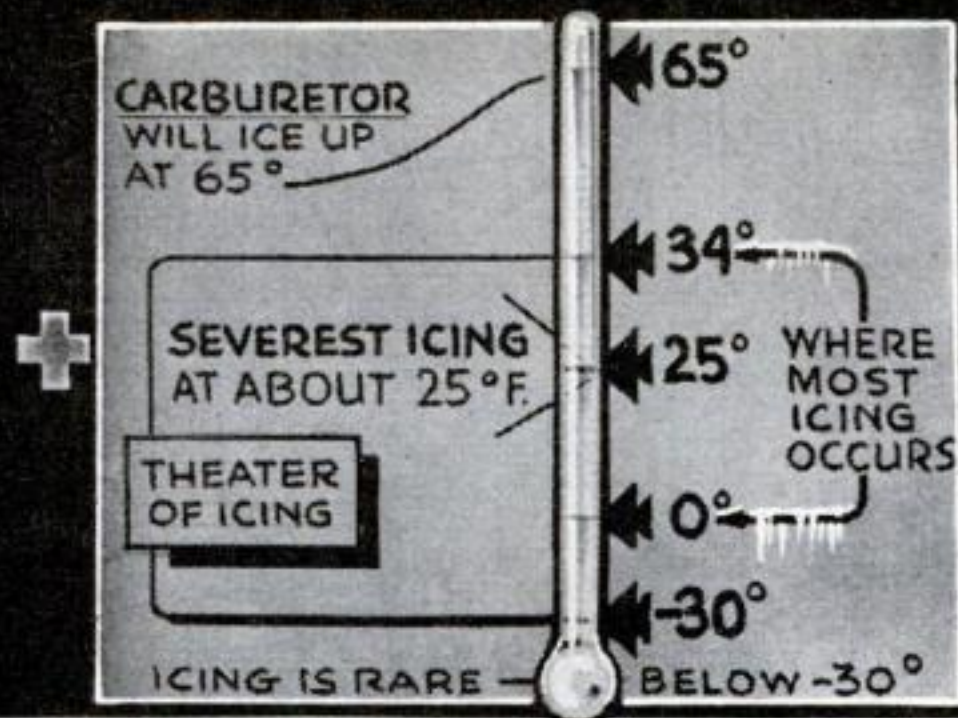
ICELAC, a chemical de-icing lacquer of the consistency of glycerin, is painted on, drying with a shiny, tacky surface. Ice-releasing chemicals in the compound afford protection until the substance loses its sheen.

← **ANTIFREEZE SHOE.** Fitting snugly over the leading edge of a propeller, the antifreeze shoe squirts a solution that de-ices the blade and lessens the possibility of more ice forming.

OF ICE FORMATION

COLD

PLANE'S MOTION



MOVING AIR SPEEDS EVAPORATION, LOWERING TEMPERATURE AND HASTENING FREEZING



Ice on a propeller, like ice on a wing, has two bad effects: the sharp, airfoil-shaped blades are turned into clumsy clubs that cannot bite the air properly, and the weight of the ice simultaneously throws the propeller out of balance. Rubber-covered spinners have been developed to protect the prop hub and pitch-changing mechanism; and a coating of castor oil or some other antifreeze can be applied before each flight.

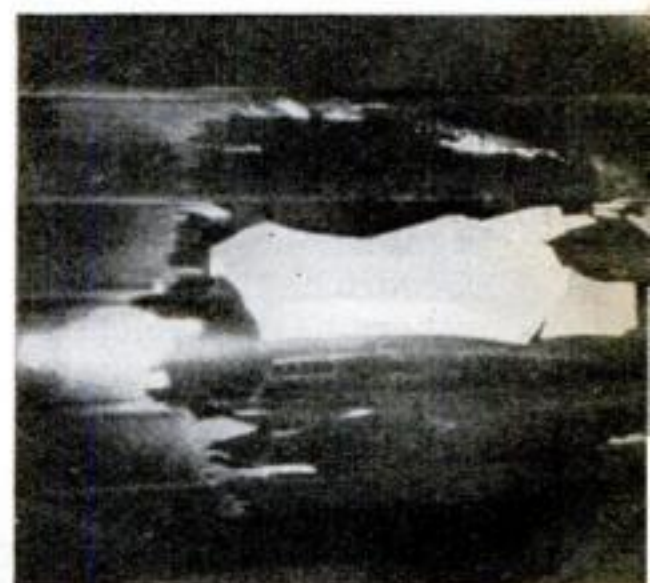
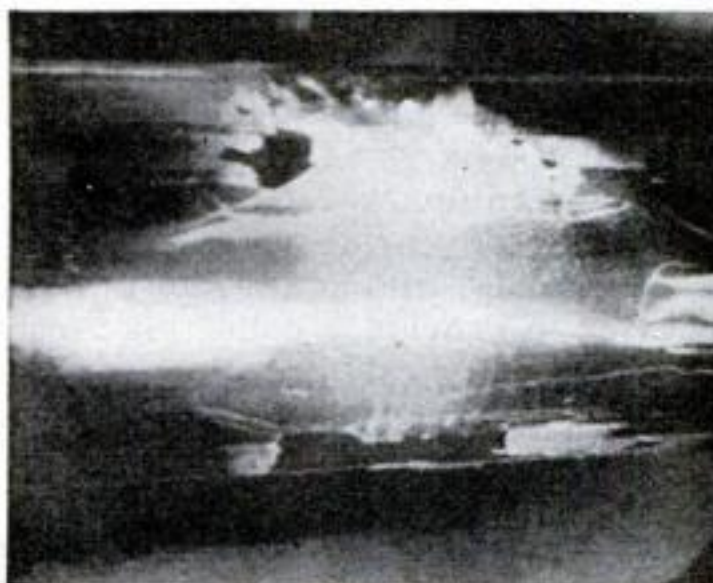
Protection of the blades is more difficult.

The "slinger ring" was the first effective device developed for this purpose. It includes a collector ring, fitted to the prop hub, through which anti-icing fluid is sprayed onto the blades from feeder tubes extending out from the ring. Centrifugal force pulls the fluid into the tubes from the ring and keeps it moving outward toward the tips of the blades. A supply line, lead-

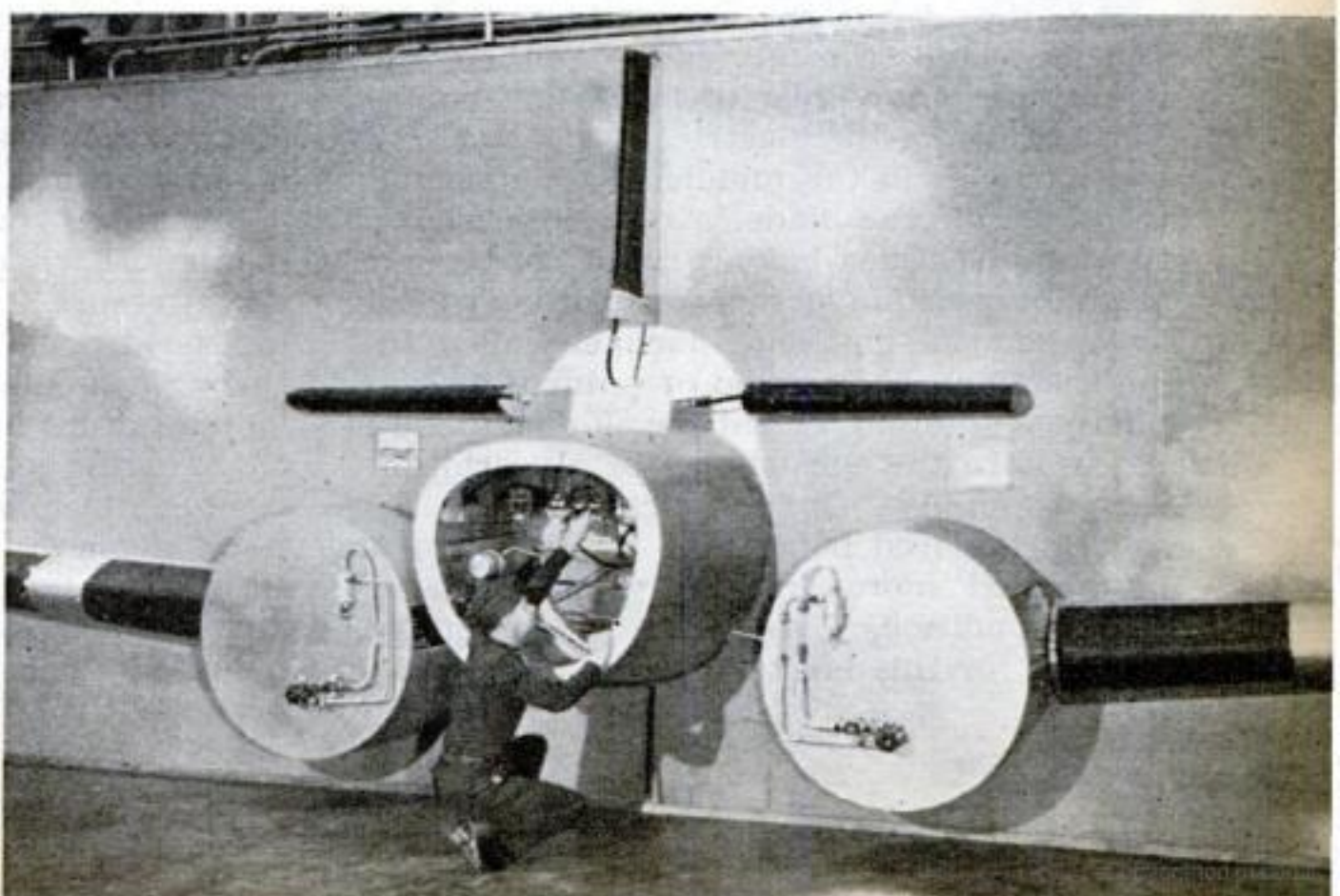
THE AIRMAN'S DEFENSE IS . . . DE-ICING

... ON WINGS

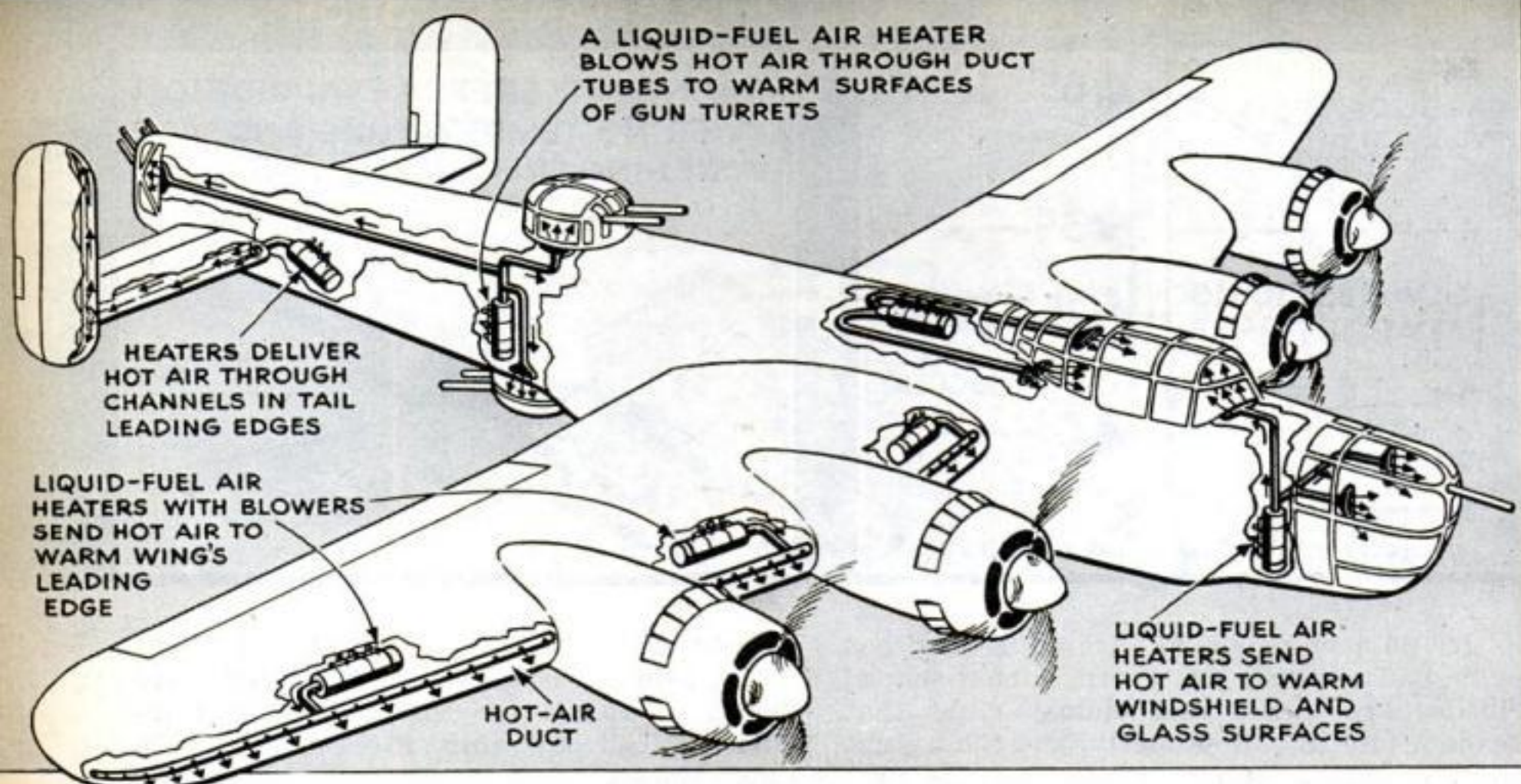
RUBBER BOOTS that expand and contract break up a wing's ice coating, which is whisked away by the airstream. Photos at right show sheet of ice before and after pulsating boots attack it. The stretchable nylon-fabric boot below fits snugly on a wing.



Here's a de-icer mockup of the Douglas C-47 Skytrain, which is used to demonstrate parts at the Western Technical Training Command School, Long Beach, Calif. Controls operating de-icers on wings and tail group may be seen within nose and on walls behind the engine locations.



AUGUST, 1945



MULTIPLE HEATERS, spotted in vital places on bombers, flying boats, transports, or fighters, blow hot air through the wings and around control surfaces, defying any frost or ice to form. Heaters operate automatically or are manually controlled, using liquid fuel. Cutaway view shows system on a B-24 Liberator.

ing from a reservoir in the plane's engine compartment, keeps the slinger ring full of pure isopropyl or a mixture of 85 percent ethyl alcohol and 15 percent glycerin. Two quarts an hour of this antifreeze solution are pumped into the ring.

Another fluid anti-icing method is to place a narrow rubber shoe on the leading edge of each blade, through which an antifreeze can be fed to the surface of the blades.

The "hot sandwich" is a newer rampart against ice on propeller blades. Goodyear, Goodrich, the U. S. Rubber Company, and others have developed this device to provide thermal protection by means of electrical heating elements. The "meat" of the sandwich is a special synthetic-rubber layer impregnated with chains of carbon particles that conduct electricity. This is insulated from the blade by a layer of nonconductive rubber that forms one side of the sandwich, and protected from abrasion or other damage by an outer layer of insulating rubber. The heat from the electrically charged carbon particles in the middle of the sandwich melts ice off the blade. Another version of the sandwich idea has a grid of copper-wire mesh between layers of protective rubber:

A chemical anti-icing lacquer called Ice-lac that may be sprayed or painted on prop blades is another recent development. It is black, with the consistency of glycerin, and easy to apply. One application may last several hundred hours, but the lacquer can be applied more frequently under severe icing conditions. Among the advantages claimed for this lacquer are the elimination

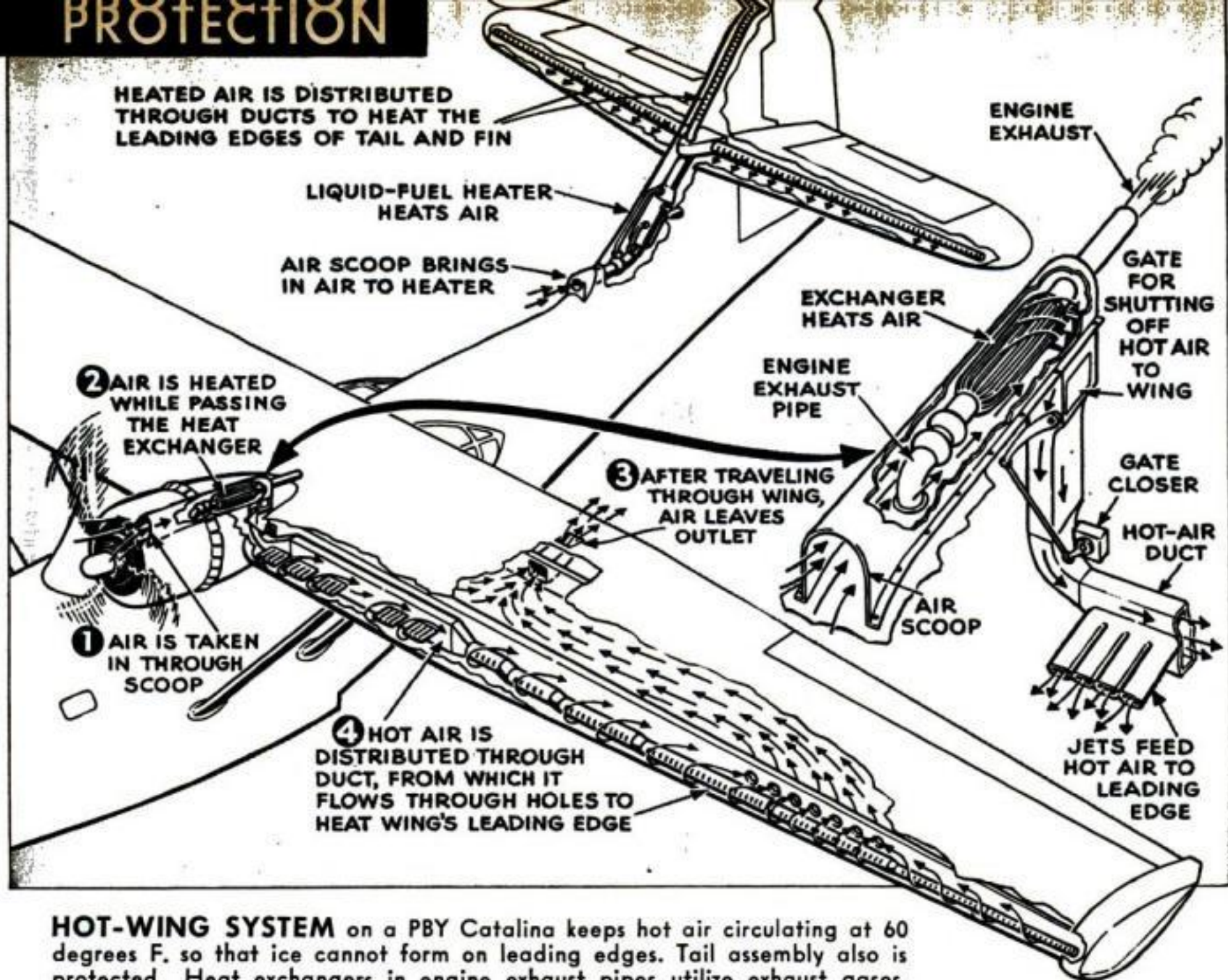
of mechanical elements and the saving of weight.

Even on clear days, in temperatures as high as 65 degrees F., "refrigeration ice" may cause carburetor trouble. Rough running and loss of power may be symptoms of this, and it is quite common. It occurs because the expansion of air and rapid evaporation of gasoline within the carburetor may lower the inside temperature as much as 60 degrees.

Two other varieties of carburetor icing are likely when other parts of the plane are collecting frozen moisture. "Impact ice" results from sleet or other precipitation in the air that enters the carburetor intake. "Throttle ice" forms at, or near, the throttle (or butterfly) valve when particles that freeze in the chilled air stream are deposited on the cold metal walls of the valve.

Many planes now are fitted, however, with carburetor heaters that use exhaust gas to warm the entering air. The newest development is an anti-icer system in which alcohol is pumped into the carburetor throat.

Ice, moreover, can queer a pilot's instruments just when he needs them most. Static air pressure is routed to the altimeter, air-speed, and rate-of-climb instruments through a pitot-tube head, and a small amount of ice in or around this opening may change the course and velocity of the incoming air in such a way that the indications given by the instruments are false. Pitot tubes now are being electrically heated, and some installations have the tube mounted flush in the wing's leading edge



HOT-WING SYSTEM on a PBY Catalina keeps hot air circulating at 60 degrees F. so that ice cannot form on leading edges. Tail assembly also is protected. Heat exchangers in engine exhaust pipes utilize exhaust gases.

instead of projecting ahead of the wing, thus lessening the exposure to icing.

Ice may weigh down and snap radio antennas just as it severs telephone lines. It may bridge over insulators and ground the antenna to the plane, and at the same time it may knock out the direction-finder loop.

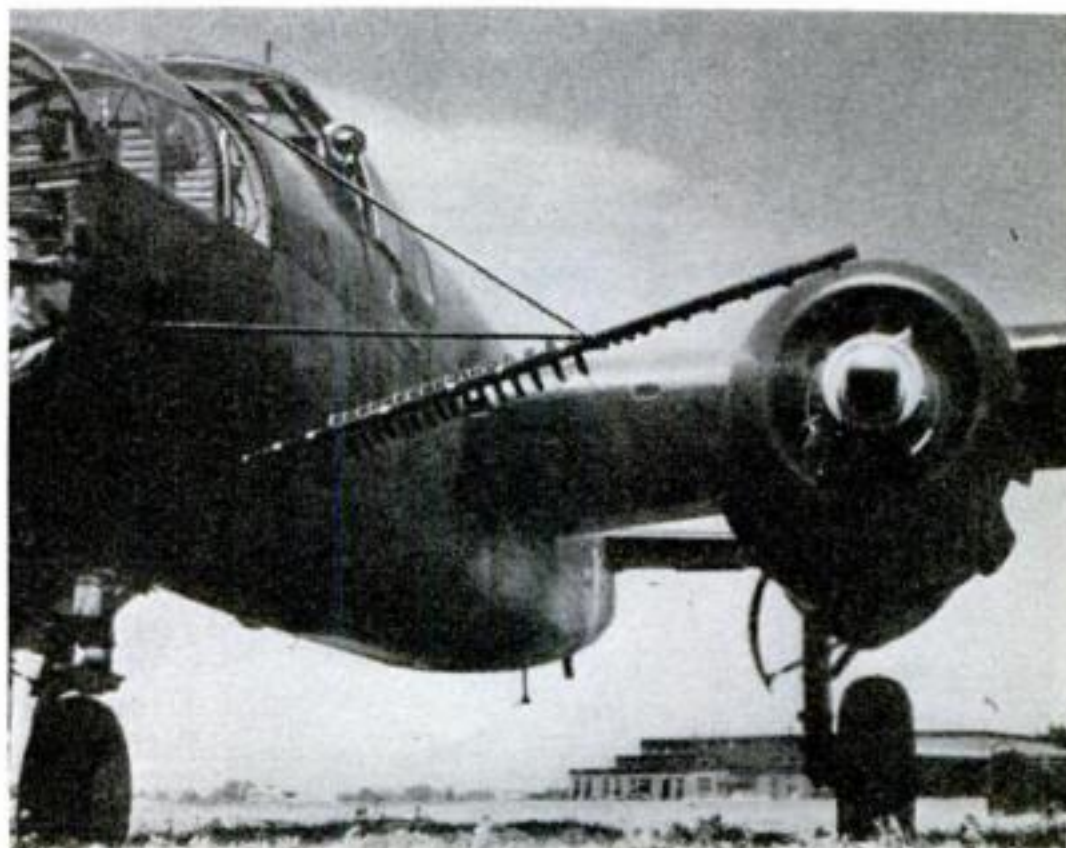
At the same time that communications and other vital parts of a plane freeze up, the windshield, bombardier's window, and even the turrets may be affected. In some

cases, this icing has been so severe that glass has had to be broken to attempt a landing, exposing pilots to 100-mile-an-hour gales of frigid air.

Ice, in fact, is so great a danger that, when it forms or is likely to form, the wisest course is to get as far away from such atmospheric conditions as possible. This is the advice of the NACA, Air Technical Service Command, and other experts experimenting with ways to beat the weather.



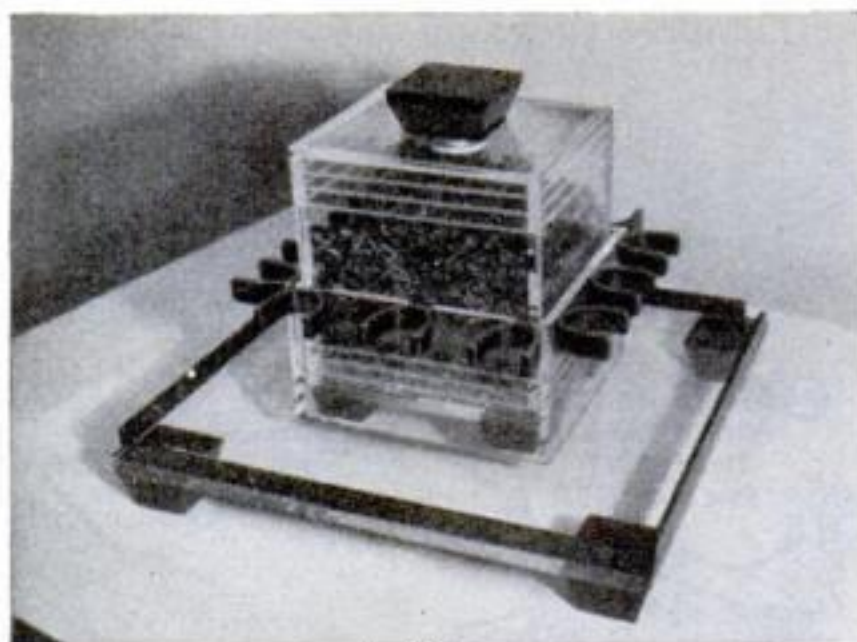
LABORATORY and field tests are carried on constantly to combat flight's icing hazard. Above, scientist studies ice formations created in a wind tunnel; outrigger spray is used in flight tests.



What's New in Modern Living



ARTIFICIAL SUNLIGHT generated by a new Westinghouse lamp is so rich in ultraviolet energy that a tan can be acquired at home three times faster than at the seashore in midsummer. Developed by the Westinghouse Lamp Division, at Bloomfield, N. J., the 275-watt lamp screws into any convenient A.C. socket and requires no special auxiliary equipment. Tests have shown that it has a life of 400 normal sun baths.



HOW MUCH TOBACCO remains in this humidor and pipe set can be seen at a glance. Designed by Delda Displays, of Los Angeles, it is made of clear acrylic plastic trimmed in black. The cover, sides, and base of the humidor are all transparent. Black plastic is used for the lifting knob, base trim, legs, and convenient racks for 12 pipes, three on each side of the humidor.

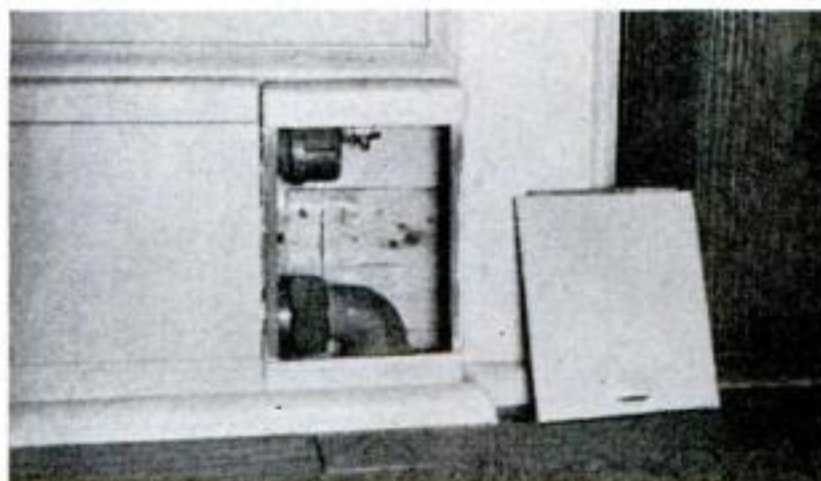


DETACHABLE HANDLES produced by Herr Metal Products, of Collinsville, Ill., clamp on any container with a bead edge. Thus a tin can becomes an adequate beer stein, and a paint container may be carried without soiling the fingers. The handles can be sprung to fit containers of various heights.

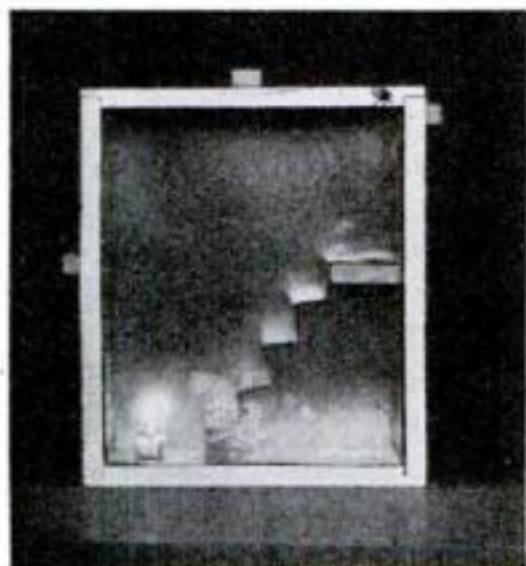
HIGH-SPEED DEFROSTING of frozen foods has now been accomplished by use of an "oven" in which the floor and ceiling are insulated electrodes connected to a high-frequency generator. Dielectric heat penetrates to the core of the mass of food, inducing uniform defrosting. In tests conducted at the Federal Telephone and Radio Corporation laboratory in Newark, N. J., frozen cherries showed thawing in six seconds. Frozen peaches in 30-lb. cartons, normally requiring 20 hours to thaw, were defrosted in less than 15 minutes. The process has been adopted by A & P food stores for thawing food in bulk.



BASEBOARDS ARE RADIATORS in an experimental home at the University of Illinois. Made of hollow cast iron in the shape of baseboards 6" high and less than 2" thick, the radiators are installed around the bottom of outside walls in place of wooden trim. Hot water coursing through the metal base-



boards from a regular boiler kept the home fully comfortable last winter. Painted a matching color, they are hardly noticeable. Pipe connections from the boiler are concealed in boxes at the ends of the walls.

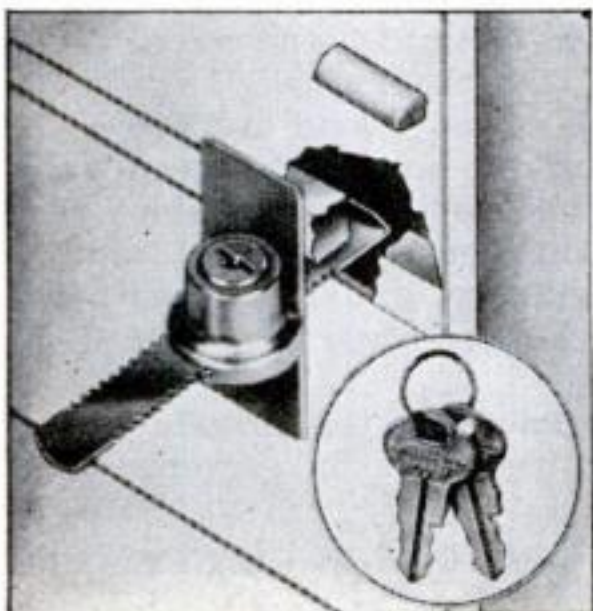


FIRE HAZARDS in the home are strikingly demonstrated by Fire Chief Howard Humes, of Ballston Spa, N. Y. Using a toy house made of metal with a glass front, he shows how easily gasoline or dust may produce fires. At the left, fumes coming from the gasoline-soaked sponge at the top of the stairs are ignited by a candle. At the right, a mixture of sawdust and cornstarch explodes when blown into the flame with a bicycle pump.



A PORTABLE LOCK developed by Wonder Lock, of Chicago, is designed to fit nearly every type of door or drawer. It consists of a closely notched ratchet bar $4\frac{1}{4}$ " long, a brace plate, and the lock proper. The thin ratchet bar fits into the latch

recess of a door or hooks on the frame at the top or bottom of a drawer. Both the plate and lock then slide on the bar, and a key is used to secure the lock. The plate keeps woodwork from being marred and makes it possible to protect two drawers with one lock. No tools are required.



PAPER CONTAINERS resembling egg cartons have been devised by Sylvania Electric Products, Inc., for the sale of light bulbs. The cartons, made in several sizes, provide a convenient place to store spare bulbs safely.





HAULING on and off the highway comes easy to the jeep. It can handle a trailed load of 5,500 lb. with a reserve for steep grades or poor footing. Note the protective wire shroud over the radiator grille.

Meet the Postwar Jeep

SPRUCE IN ITS CIVILIAN GARB, THE LITTLE BATTLE BUGGY IS READY FOR VARIED NEW CAREERS ON U. S. FARMS AND RANCHES

SAUCY and seemingly indestructible, the jeep has captured the fancy of America. Ever since, five-odd years ago, the Army's $\frac{1}{4}$ -ton truck bounced off the drawing board and into the newsreels, owning one has been something of a goal for thousands of citizens. That this will be possible was revealed recently when Willys-Overland, one of the three makers of wartime jeeps, announced plans for marketing a postwar version on a world-wide scale.

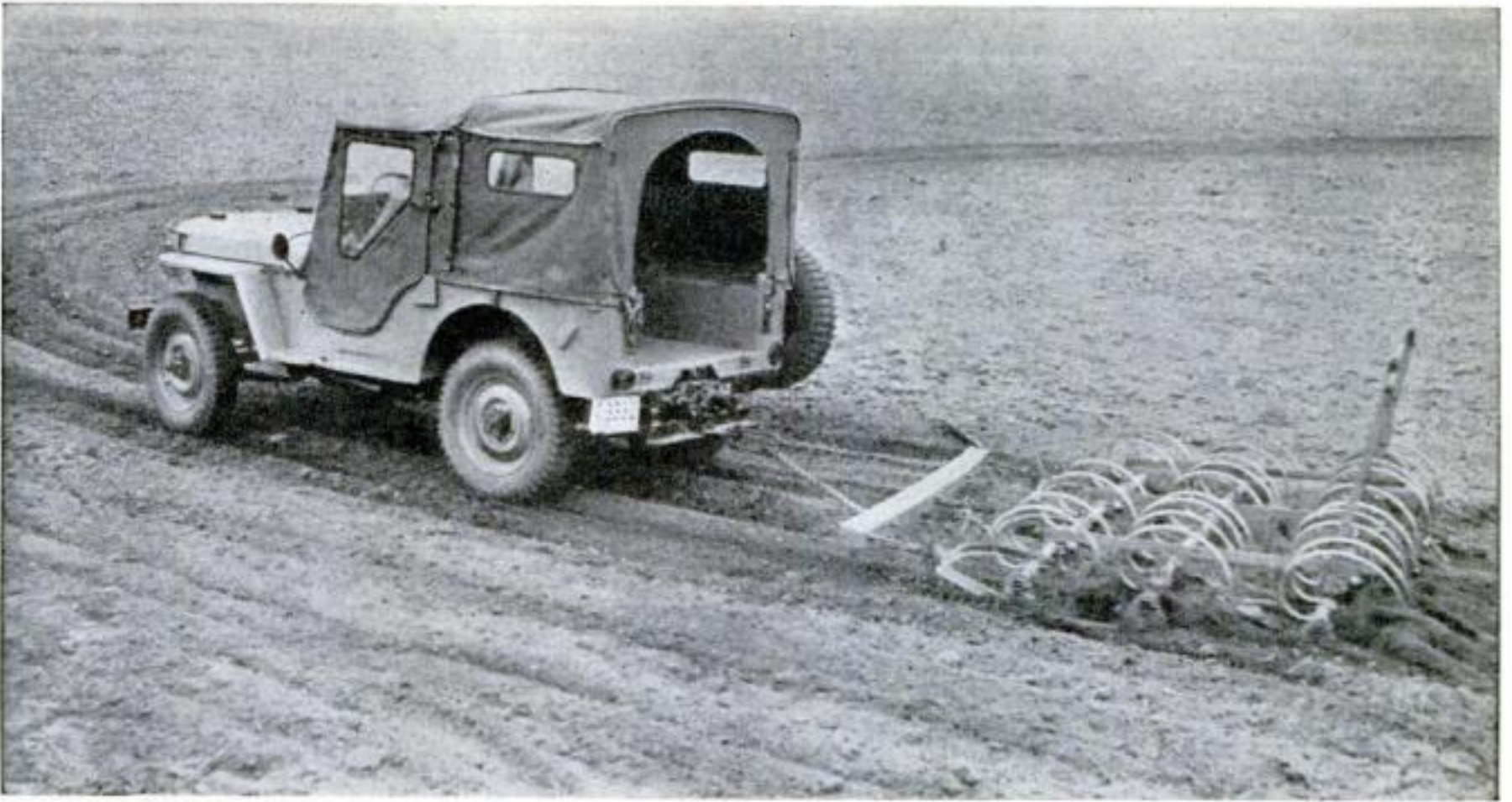
Essentially the same as the wartime jeep (Model MB), the new vehicle (Model CJ-2A) will have a number of modifications designed to suit it better for civilian use, mainly on the farm. A different body, a new radiator shroud designed to give ample cooling during prolonged pulling in low gear, new gear ratios and a larger clutch, and a power take-off in the rear are among the most important changes. According to Willys-Overland, the postwar jeep is conceived of as a single vehicle that combines the basic functions of a light truck, a tractor, a passenger car, and a mobile power plant.

The power take-off, offered as extra equipment, is designed according to tractor standards for driving towed farm implements. Through a $1\frac{1}{8}$ " spline shaft that

turns clockwise when viewed from the rear, it delivers to the implement approximately 25 hp. when the jeep is moving at 4.2 m.p.h. A separate 8" pulley-drive unit may be attached to the power take-off shaft and furnishes 30 hp. at a belt speed of 3,100 feet per minute. The drive in both cases is by an independent propeller shaft that extends back from the transfer case and is engaged by a shift lever beside the driver's seat. A governor, also provided as extra equipment, permits regulated engine speeds from 1,000 to 2,600 r.p.m. in steps of 200 r.p.m.

The four-wheel drive of the military version has been retained and is expected to be particularly effective on uneven or loose soil. Tests with the new model indicate a sustained drawbar pull of 1,200 lb. may be achieved, with reserve for grades and irregular soil conditions. On the highway, the postwar jeep will pull a trailed load of 5,500 lb. with adequate reserve power for steep grades. A larger clutch, wider transmission teeth, and slightly different ratios in the transmission, transfer case, and front and rear axles are other changes made to permit heavy pulling.

Except for a new generator, the omission of static-suppression devices, and several

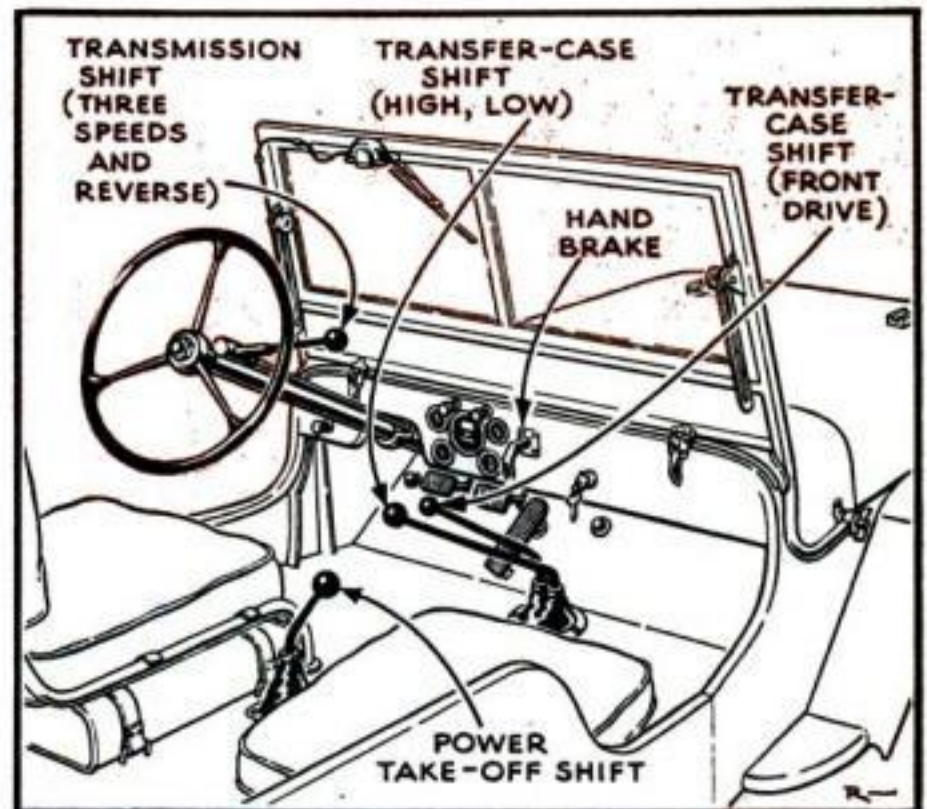


CULTIVATING is another farm job the jeep can tackle. As shown above, the body differs from that on the wartime jeep in having a detachable tail gate, a new kind of top, and a spare tire mounted on the right.

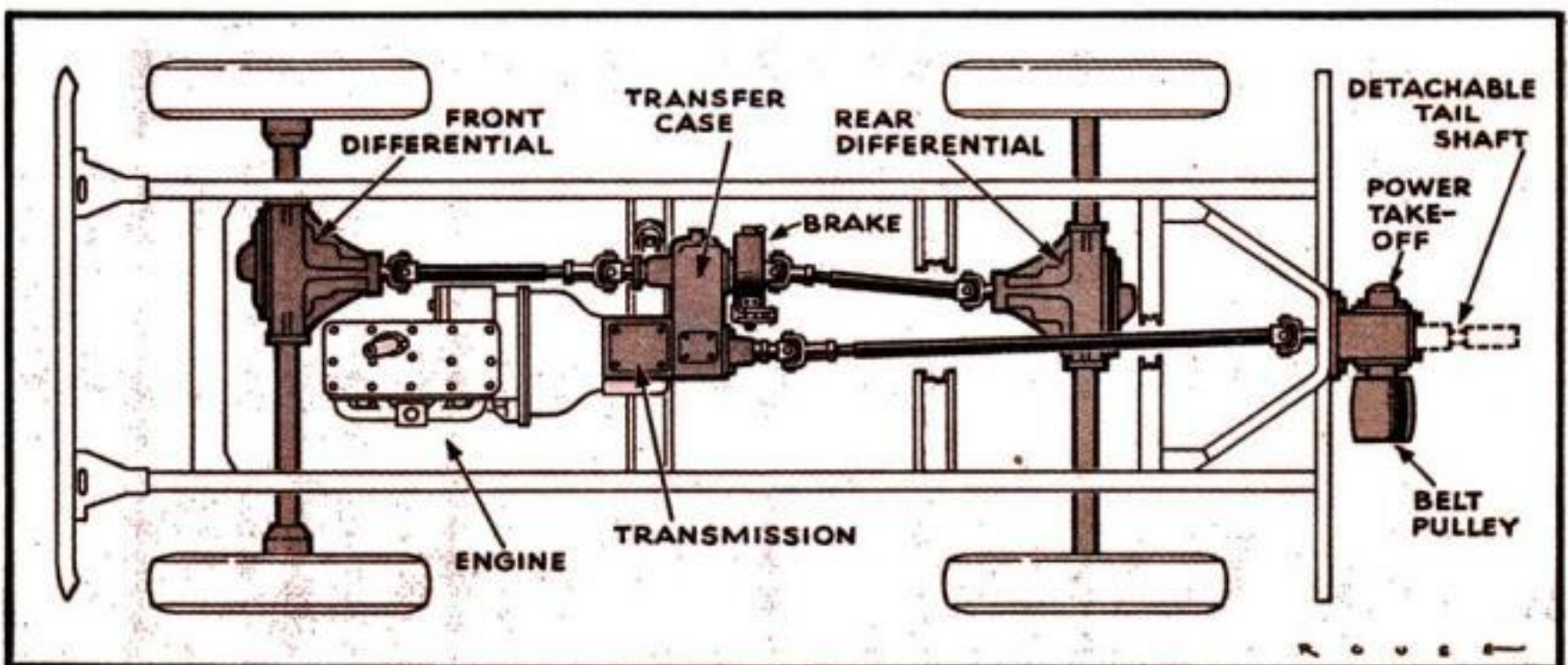
other minor adaptations, the engine is the same as that used in more than a half million wartime jeeps. It is a four-cylinder, L-head engine with a displacement of 134.2 cubic inches, a compression ratio of 6.48 to 1, and a rated output of 60 hp. at 4,000 r.p.m. Gasoline consumption on the highway is reported to be 18 miles per gallon. Top road speed is 60 m.p.h.

The body, of welded 18-gauge steel, differs from that on the military jeep in that the spare tire is located on the right side, a detachable tail gate is provided at the rear, and the back seats are removed to give greater carrying capacity. A passenger seat beside the driver and a double rear seat are available as extras. The gasoline tank, which has a 10½-gal. capacity, is beneath the driver's seat.

[Turn the page.]



Four shift levers are spotted near the driver's right hand. Below, the various power trains are illustrated.





POWERING various kinds of farm implements is done through the take-off. As much as 30 hp. is available from the belt pulley.

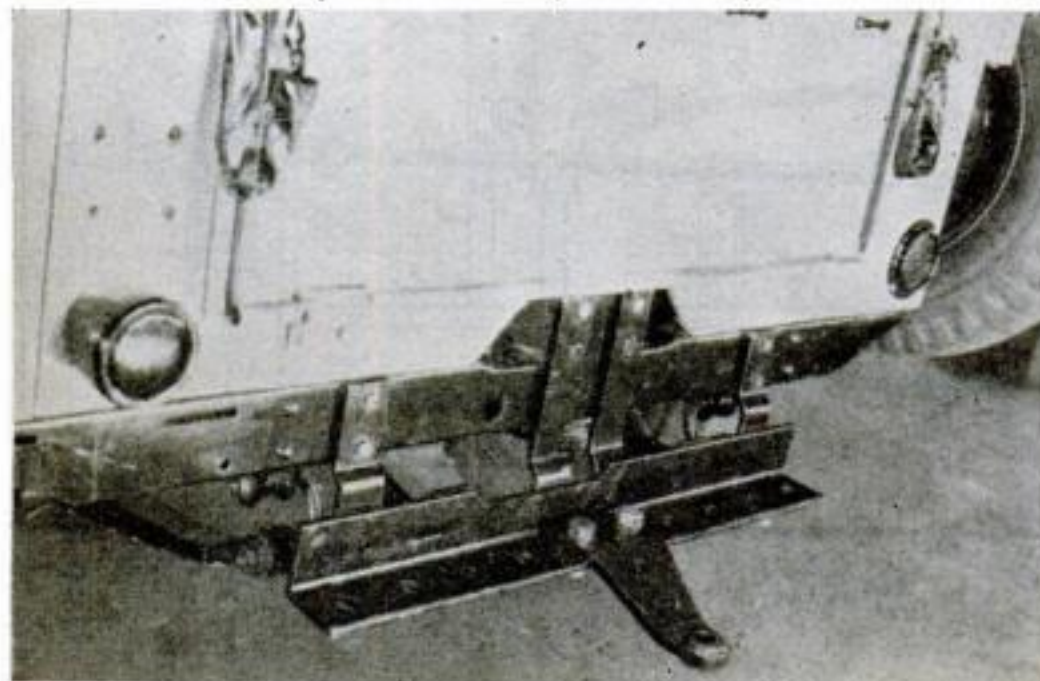


PLOWING SNOW with the postwar jeep is aided by the four-wheel drive, traction-tread tires, and gross weight of 3,420 lb.



SPRAYING paint or insecticide is another jeep job. Here a paint-spraying compressor is driven by the power take-off shaft.

TOWING either farm implements or a trailer is done with this drawbar. The power take-off, not shown, doesn't interfere.



To cast light on the question of what jobs the jeep will do best, Willys-Overland has engaged in extensive testing in cooperation with numerous agricultural colleges and experimental stations. The list of different jobs that it has tackled is almost as big as farming itself; it includes plowing, disking, dragging, planting, and cultivating; operating a combine, binder, threshing machine, and elevator; hauling, raking, sawing, spraying, pumping, digging post holes, and spreading manure.

Other than on the farm, numerous different applications for the postwar jeep have been envisioned by its makers, and some have already been tried out. Among them are operating a light plant, maintaining phone and power lines, herding cattle and sheep, serving as a police car, skidding logs, switching yard freight, acting as an airport tug, digging wells, plowing snow, fighting fires, and stretching fence wire.

Recognizing that some farm experts have predicted that jeeps would be inefficient or expensive in certain tasks, the makers point out that the postwar model was not designed to compete with any specialized equipment, limited in function and therefore necessarily standing idle much of the time, but for constant service, day in and day out, all through the year.

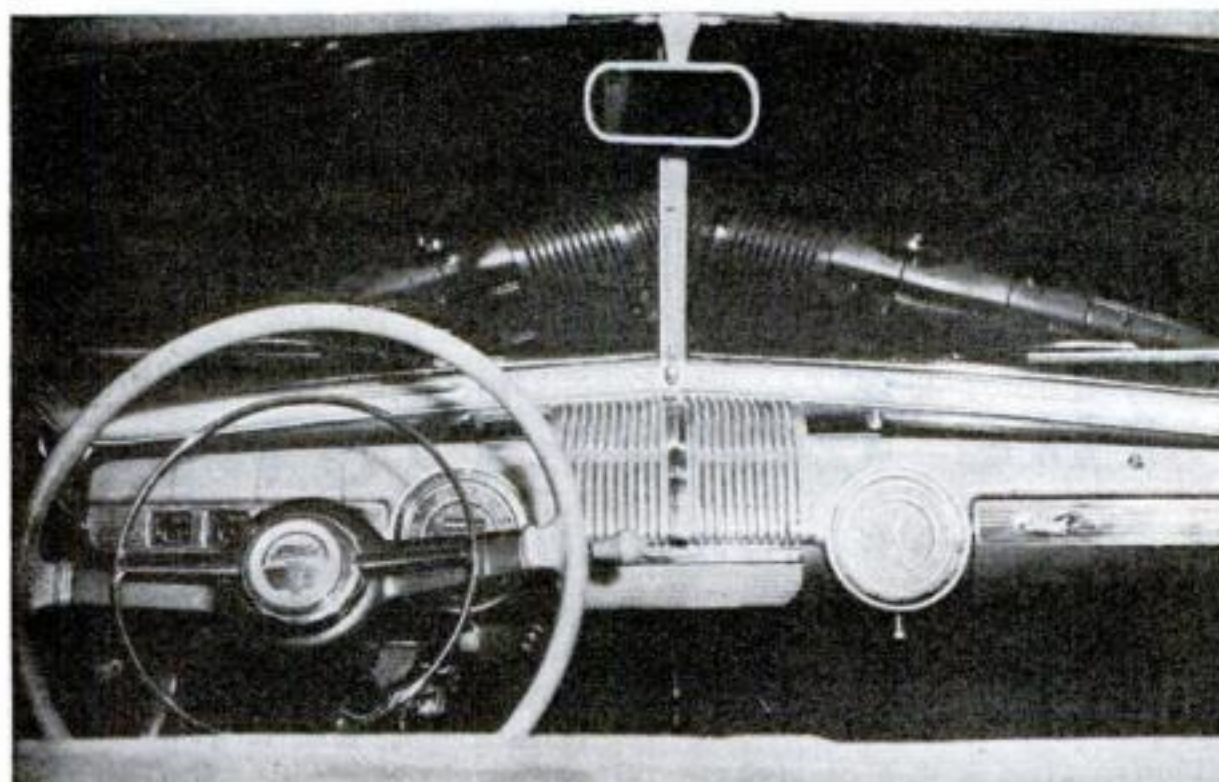
BORING post holes is a tough job to tackle without power, but it becomes an easy task with the rig shown above. The jeep may also be used as a well driller.



Ford and Nash Show First New Cars



Front of the 1946 Ford, above, looks different from 1942 models due chiefly to changes in the radiator grille, parking lights, and trim.



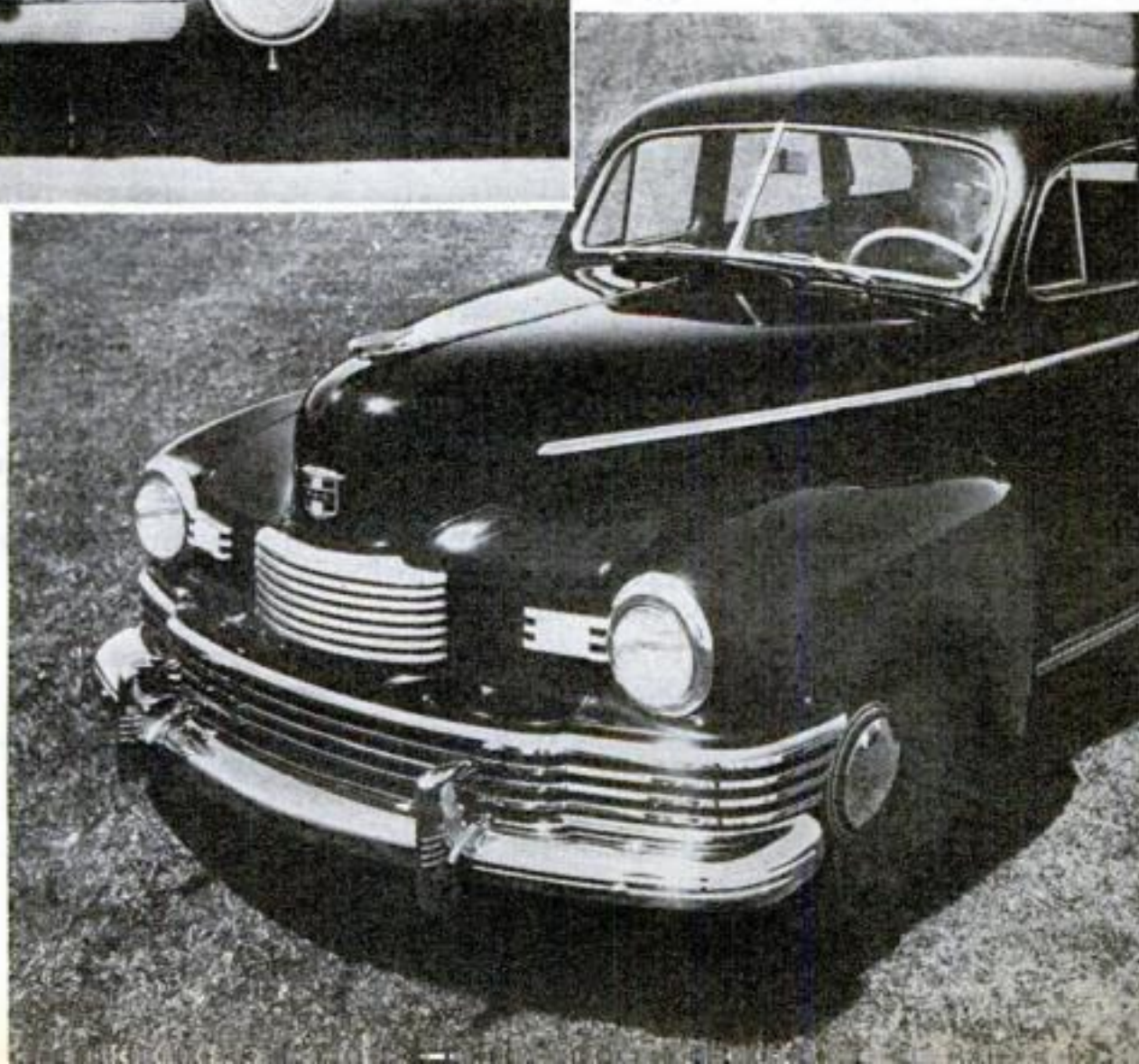
The steering wheel and the instrument panel of the new Ford, above, also reveal a strong basic resemblance to the ones in the last prewar models. The car appearing in this and the upper photo is a pilot model built by hand, not a production job.

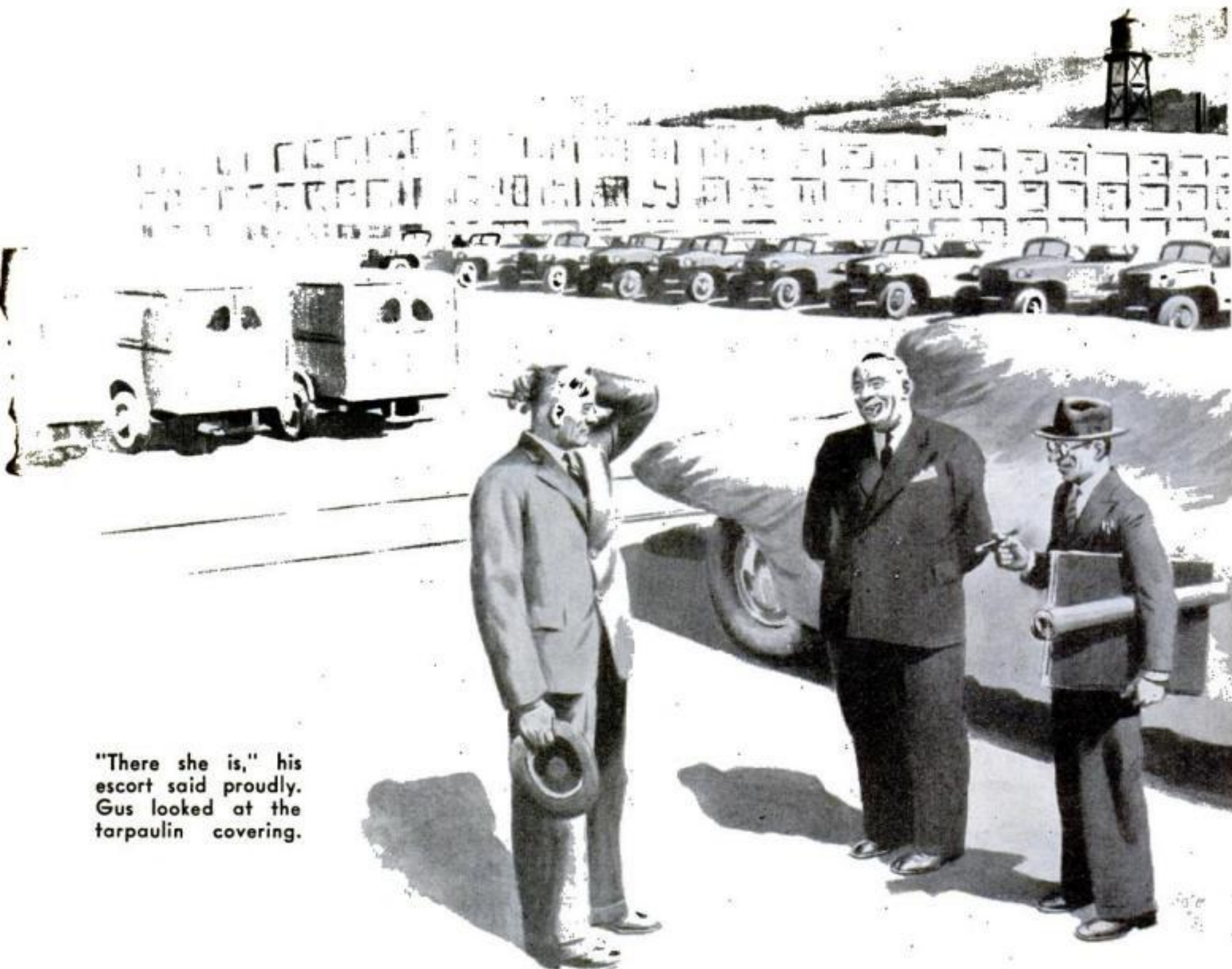
Restyling of the Nash "600" brings the massive-looking design shown at the right. Weight has been reduced by 500 lb. as compared to equivalent prewar models.

AS THE wraps come off the first U. S. cars built since shortly after Pearl Harbor, predictions that new models would resemble the prewar ones are borne out.

The first Fords feature different styling of basically the 1942 body design, plus a number of mechanical improvements, among them new crankshaft bearings, greater volume and pressure of engine oil, relocation of valves for better cooling, a new distributor, an oil cleaner, an oil-bath air cleaner, and modified shock absorbers and springs. Further Ford plans are unofficially reported to include manufacture of one car 15 to 20 percent under prewar Ford price levels, and of another with a five-cylinder in-line engine.

Styling and mechanical changes characterize the Nash "600", which is in the low-priced field. Elimination of the frame in favor of a combined body-and-chassis construction has reduced weight by 500 lb. and has made possible gasoline mileages of from 25 to 30 miles per gal. All wheels have individual coil-spring suspension.





"There she is," his escort said proudly. Gus looked at the tarpaulin covering.

Gus Gets the Low-Down

IMPROVEMENTS ARE COMING, HE FINDS, BUT THE OLD BUS

By Martin Bunn

WHEN the WPB gave the green light for production of 200,000 cars this year, the Model Garage regulars could hardly wait for the first rainy Saturday afternoon. Arguments over what the new cars would be like were going hot and heavy—backed by offers of cash bets—when Gus Wilson rapped for order with a peening hammer.

"Pull over, you fellows, and let your engines cool," he laughed. "Do you realize you're just telling each other what you want in your new car—not what you expect? George Knowles here wants a big, powerful car for vacation trips. Ez Zacharias is thinking of a model that can take it on back-road, RFD routes. Doc Marvin wants mileage on city streets. Tim Sheridan—"

But we were too sure of ourselves to let

Gus finish, and just then his partner, Joe Clark, walked in from the office.

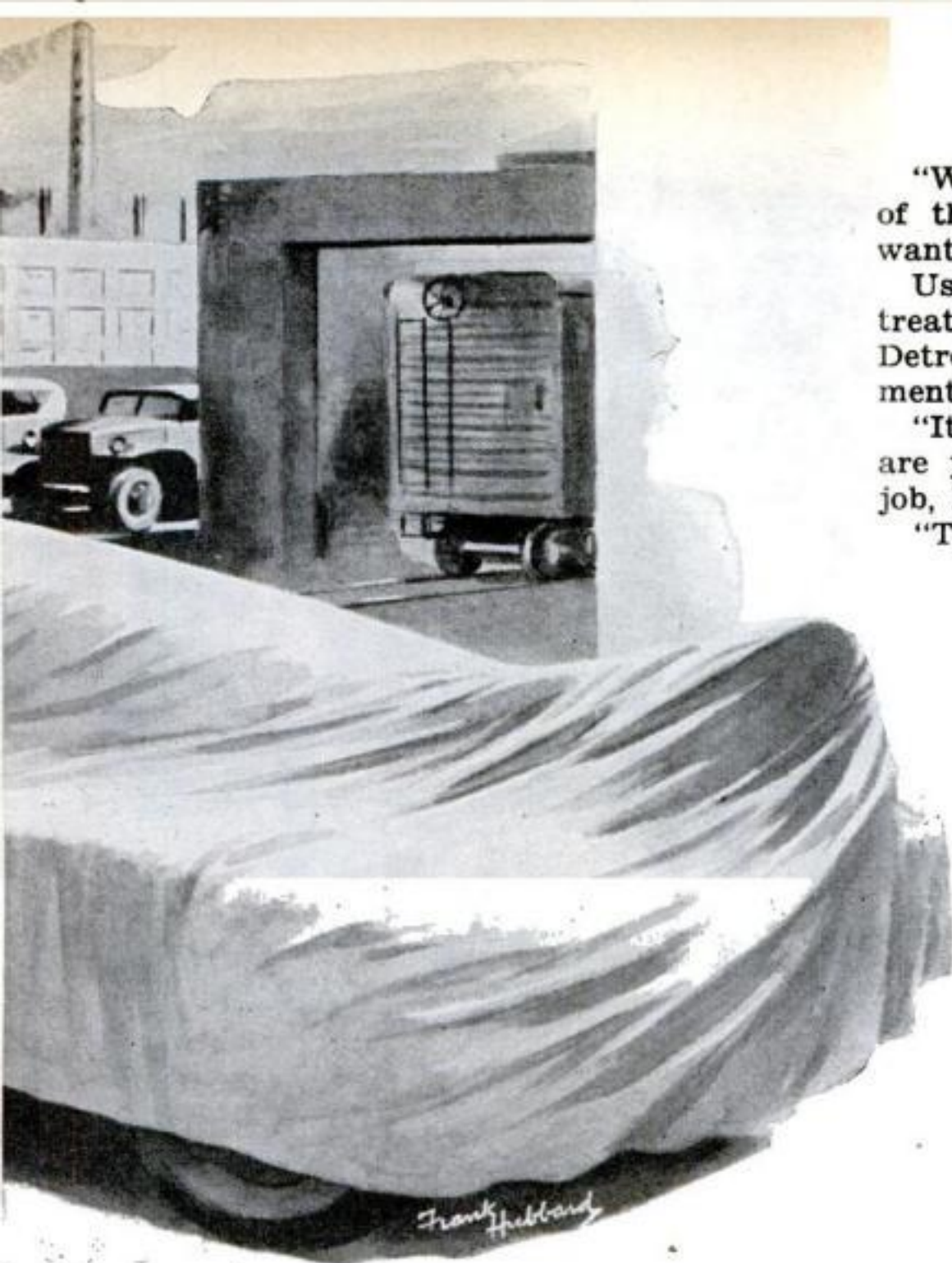
"Why don't you make a sweepstakes of it," he asked. "Everybody put up \$10, and the winner take all. Gus is going to Detroit anyway. He can find out what's what."

"I'm going," Gus agreed. "But it's to find out what chance some of our customers have of getting new cars before they get expensive repair jobs on their old busses."

He went that night, and early the next morning he got off the train with a mild upper-berth grouch that was dissipated by a cup of coffee at the station lunch counter. While he was drinking it an important-looking individual sat down next to him, snapped his order at the waitress, looked Gus over, and asked: "Automobile man?"

"Well, sort of," Gus admitted modestly.

"Thought so—I can always tell 'em. What do you think of that new job Oldsmobile is



on the New Cars

MAY STILL HAVE TO DO FOR A WHILE

going to put into production when they clear out the aircraft work at Lansing?"

"I haven't heard about it," Gus told him.

His new friend had a self-satisfied grin. "Not many have," he said. "This town is full of gossip about the new cars, but only we on the inside get the real low-down."

He looked around suspiciously, leaned toward Gus, and lowered his voice. "This new Oldsmobile has real joy-stick control—just like an airplane—that ties in with its hydromatic transmission. If you pull back the steering wheel, the brakes go on. And when you push forward, the throttle opens and you get more speed. Neat, hey? And I'll tell you something else—the Olds will be the first General Motors car that you'll see in the salesrooms."

Gus watched him go out, and then, after a second cup of coffee, phoned an old friend who is something in General Motors.

"Who?" asked the voice at the other end of the wire. "Gus Wilson? Of course I want to see you! Come now, if you can."

Ushered into an impressive office, Gus was treated like visiting royalty. "Looks as if Detroit has been good to you," he commented.

"It has," his friend admitted. "But what are you doing here, Gus? Looking for a job, I hope. We could use—"

"Thanks," Gus said, "but I've got a business of my own to look after. It isn't as big as this one, but it suits me fine. What I came to Detroit for was to find out about the new cars." Then he told what he wanted to know and why he wanted to know it.

His friend grinned. "You sure do give your customers service!" he said. "Well, you know what the situation is. Reconversion is a tough job, and some materials—especially rubber, textiles, and wood—are hard to get, but we'll make out. This year's cars, and probably most of next year's, will be rationed. Those customers of yours whose busses need repairs had better have them done."

Gus nodded. "That's the way it looks to me," he agreed. "But how about new designs and engineering features?"

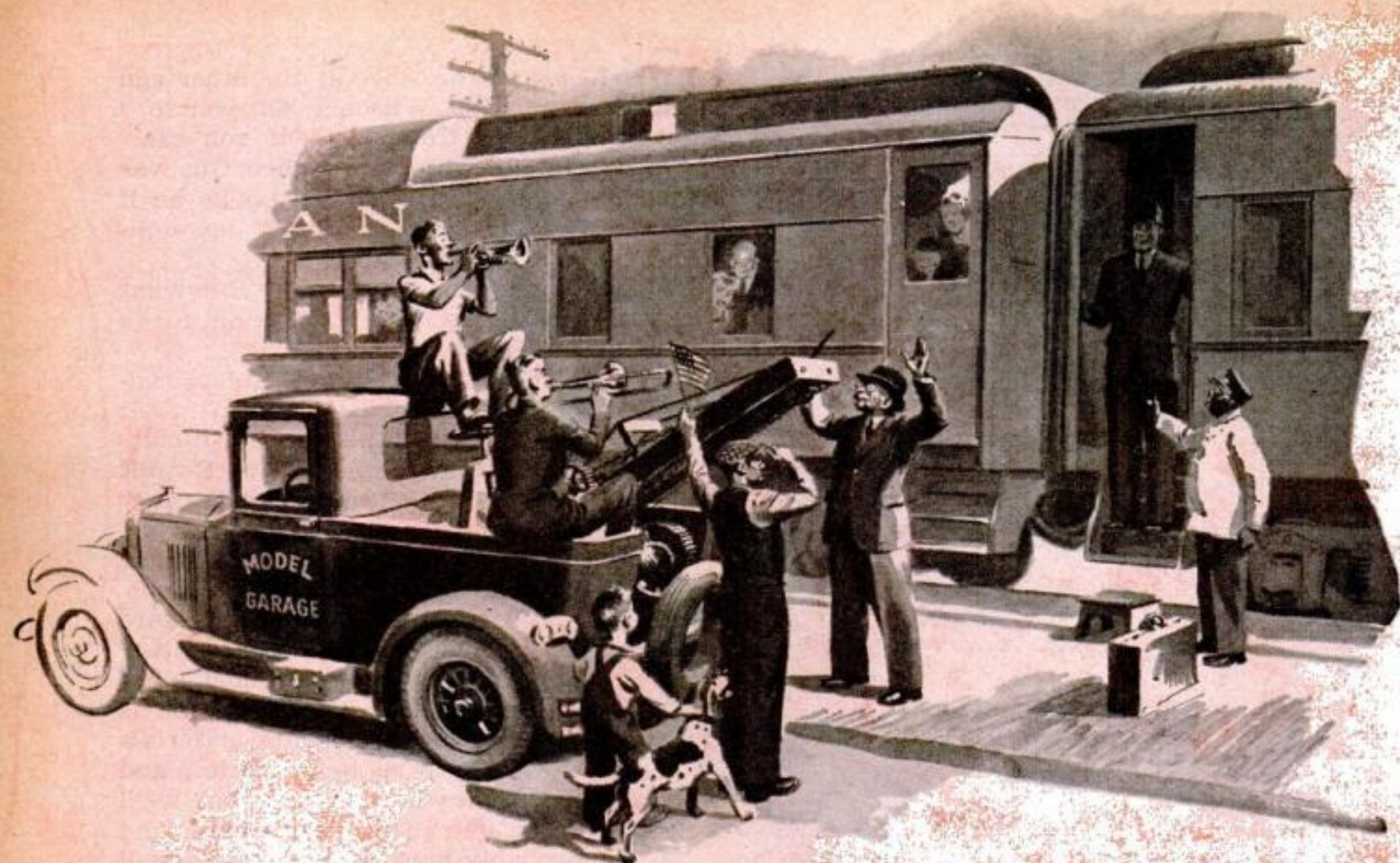
"Well," the reply was cautious, "this automobile business is highly competitive, and manufacturers generally don't do much talking about new features until a car's in production—there's always a chance that some competitor might like the idea and redesign his sales campaign even

if he didn't have time to redesign his car.

"I hear a lot of things, of course, but it's hard to separate truth from hooey. It's a fact, of course, that Willys-Overland is going to build jeeps for farm use—pretty much the same as the Army jeep, only the transmission gears and the transfer case are strengthened, and there is a power take-off. Then someone was telling me that Graham-Paige is designing an entirely new car with a 100-hp. six-cylinder engine in the rear. And Ford—you ought to see the Ford people."

"I'm going to," Gus assured him. "But you haven't told me anything about your G.M. cars—that \$500 Chevrolet I've been hearing rumors about, for example."

The man became even more cautious. "We're doing more war work than any other company, so we're facing bigger reconversion problems," he said. [Turn the page.]



When Gus got off he was greeted by Stan Hicks and some of us regulars who had come in the wrecker.

"I doubt if we will bring out a brand-new postwar car before 1947. We expect to be able to produce our quota of 95,000 cars this year. They'll be modified '42 models, but they'll have plenty of improvements—nearly every part has been improved since the beginning of the war, and we are going to pass a lot of improvements along to the car buyers. We're going to keep the price of the '46 Chevrolet as low as possible, but it'll be over \$500. The new light model is for later on. If you're looking for something sensational, Gus—"

"I'm not," Gus cut in. "But I've heard about something sensational. How about that Oldsmobile with joy-stick control?"

"Joy-stick control, hey?" his friend asked. "First I've heard of it, but it could work." His telephone buzzed, and he answered it. "Sorry, Gus. I've got to go to a conference. If you're in town tomorrow, give me a ring and we'll have lunch together."

Gus has another old friend who occupies one of the seats of the near-mighty in the Ford organization. He was cordial and enthusiastic when he saw Gus. "Will I tell you about our new car?" he repeated. "I'll do better than that—I'll show it to you!" He led the way into a large room. A shiny car stood in the middle of the floor. "There she is—all handmade, but just like the Fords we're putting into production."

Gus ran his experienced eyes over the car. "What's under the hood—one of those new five-cylinder engines?" he asked.

"Not on this model," he was told. "But they might use one in the lightweight, lower-priced car that may be coming along soon. They've been experimenting with three different engines, one of them a five-cylinder in-line and one a five-cylinder radial."

"But this baby has plenty of mechanical improvements that will give the buyer greater economy in operation and increased riding comfort. It's a good car."

Gus dropped in to see a couple of other old acquaintances, and from them gathered that new Packards will be on the road by October, that new Chrysler models were still in the clay state in the designing rooms, and that the Dodge engineers were concentrating on a new six-passenger closed model.

By then his stomach was insisting that it was time to eat. He went into a crowded restaurant and was shown to a table where two men were talking earnestly. "Textiles are the worst bottleneck," one of them was saying. "Upholstery and backings depend on textiles, which aren't to be had. So how are they going to turn out cars?"

"That's not bothering Ford," his companion came back. "He's going to use his own spun-glass products for upholstery and

floor coverings, according to the grapevine."

Gus decided to call on another old friend—now a hot-shot publicity man. As Gus had expected, he admitted he was very much in the know.

"Watch Marshall Field," he told Gus portentously. "I hear he's going to take up along the same lines that Henry Kaiser did—that he's made big offers to several top engineers and production men to go to Chicago and help create a sensational new automobile. And watch Hudson. It's been denied, but there's more than most people think in that story that the Fisher brothers want to take over Hudson."

"That's exciting," Gus said, "but it's out of my line. I'm not so much interested in who makes cars as I am in the low-down on what models they're going to make this year."

This elicited a frown. "New models—that's something I can't talk about, even to you. I know a lot about them—but you realize that the confidential relationship between a professional man and his clients must be respected. But let's see. I could arrange—"

He spent a few minutes at the phone. "I've fixed it for you to see the most revolutionary automobile ever designed," he told Gus.

It was quite a long ride. They stopped at a signless side gate of a small factory. Inside they were greeted by two men who carried rolls of blueprints, and they were escorted to a courtyard in which stood an automobile covered by a big tarpaulin.

"There she is," one said.

Gus looked at the shrouded car and then at their escorts.

"That's all you're going to see, mister," one of them snapped. "That cover doesn't come off until the car is in production. I'm not going to have my ideas stolen!"

"I'm sorry," Gus's friend said when they were back in his car. "But you know how inventors are. Can I drop you anywhere?"

"Yes," Gus said, "you can drop me at the railroad station. I'm going home!"

WHEN Gus got off the train the next morning, he was greeted by the strains of "My Merry Oldsmobile" rendered by some of us regulars who'd come with Stan Hicks in the wrecker to meet him. All Gus did was smile rather

wanly at our orchestral effort. He wouldn't talk until we got back to the Model Garage, where half a dozen other sweepstake holders were waiting.

Gus grinned sheepishly. "I suppose you want to hear my report," he said. "All right. From what I heard, none of you has a chance to buy a new car for a long time, so you'd better keep your old busses running for another year—maybe two years."

"But who wins the sweepstakes?" we asked.

"Nobody—not now," Gus told us.

There was a howl and a babel of demands to know what Gus meant.

"But their money," Joe put in when he could make himself heard. "You have to decide whose idea is nearest what the new cars will be, Gus, so the sweeps can be paid."

"Let's hold the money," Gus smiled. "I'll decide when all the '46 cars are in the sales-rooms!"

"That's fair," Ez Zacharias acknowledged. "But it'll keep our money tied up."

"No it won't," said Gus. "I've got a sure cure for that. And it ties right in with my breakfast, which I haven't had yet. Come along."

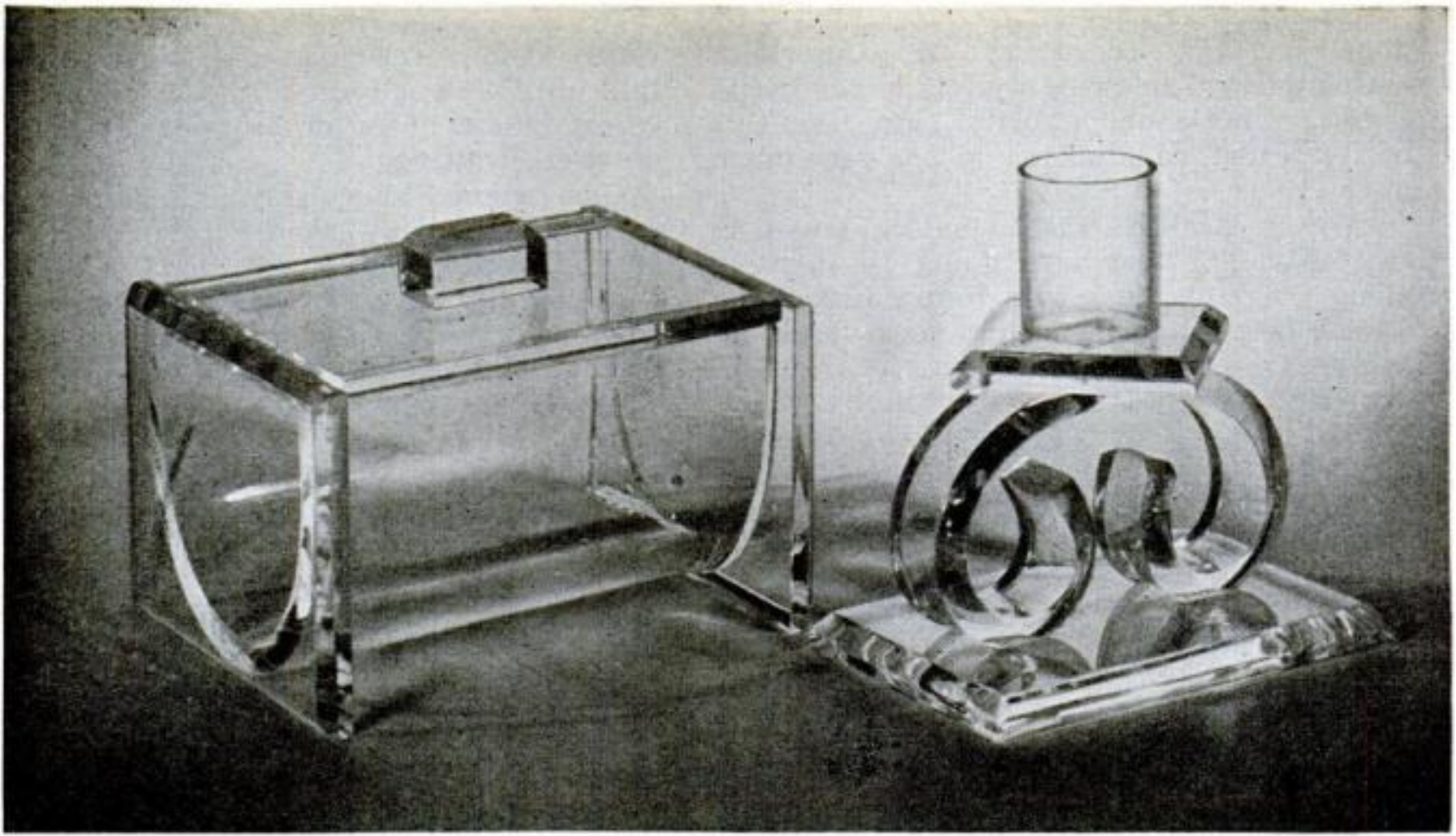
Puzzled, we followed him to the Park House, straight to the War Bond booth in the lobby.

"And that," he grinned, waving the bond he'd bought, "is what all of us had better do until the new cars really get rolling."

Nobody argued with him.

We all went to the Park House and helped him buy the bond.





CLEAR PLASTIC—JEWEL OF CRAFT MATERIALS

By Maurice Lannon

WORKING clear plastic is not nearly as hard as calling it by its scientific name—polymethyl methacrylate resin or just acrylate resin. It is no more difficult, as a matter of fact, than working wood and is much simpler to handle than metal. You can saw, drill, and carve it and sand and buff it to a sparkling finish; you can turn it in a lathe, tap it, or thread it; you can heat it and then bend it with nothing more than your hands; and you can cement it so firmly that the joint actually becomes a weld.

This is the tough, transparent material of which warplane gun blisters are made. Commercially it is known as Lucite and Plexiglas. It is destined to become indispensable in home workshops for small craft projects, for its quality of catching and reflecting light permits a jewel-like finish. Prisms and lenses made of it have many of the properties of the best optical glass.

Sawing. For straight sawing, a circular saw is best. Use a sharp one with fine teeth. It should have no set, as too much may chip plastic and even a little adds to the work of sanding. Teeth saw better if they have no hook. One trick is to reverse the blade so it will run backwards. Hollow-ground blades are a help. The plastic may also be cut with a hacksaw or some other fine-

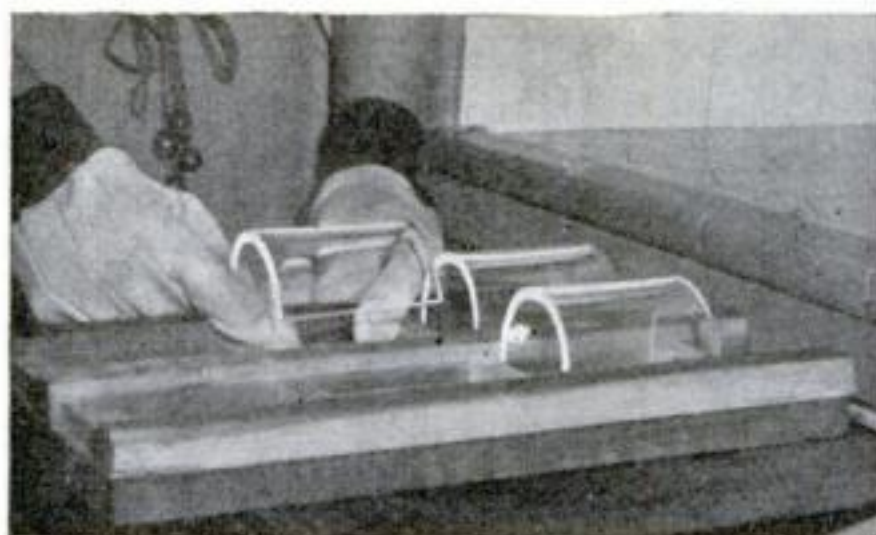
toothed saw. A jigsaw or bandsaw will cut curves. Keep a circular-saw blade as low as possible.

Sanding and buffing. Sawing leaves a rough, opaque edge that wet sanding and buffing will make clear. Dry sanding produces a frosted effect. For either wet or dry sanding, use a 150-grit paper first and then a 400-grit paper. Place the paper on a flat surface and work the piece on it, using plenty of water for wet sanding. Rough sanding may be done on a sanding disk, or the piece may be filed.

Buffing should also be done twice, with a coarse and then a fine wheel. For an 8" wheel, a speed of 1,850 r.p.m. or slightly higher is about right, but smaller wheels and even hand-grinding wheels can be used. Be sure the wheels are clean. Charge the coarse wheel with tripoli and the fine wheel with a still finer cake. Hold the work tangent to lessen wear on the wheel and exert firm but not excessive pressure.

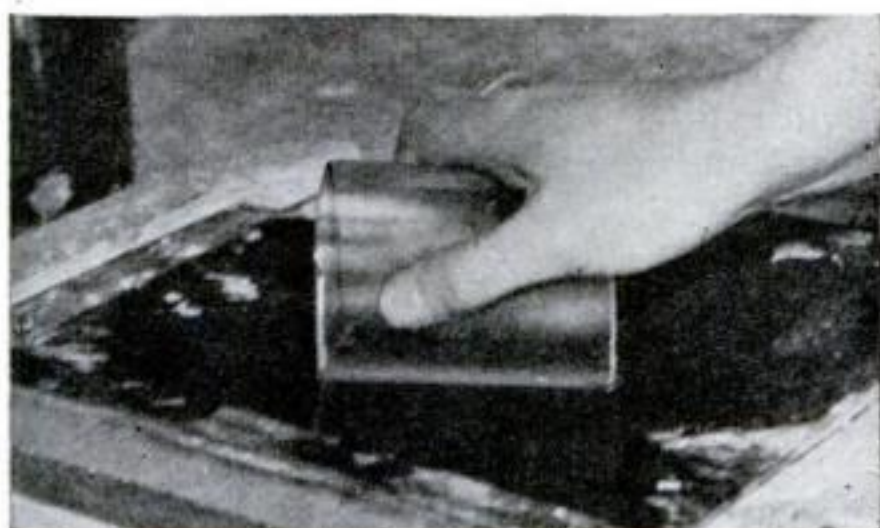
Bending. Heat clear plastic in any heat-control oven—a kitchen oven will do—to no more than 325 deg. F. More heat blisters the material. Use gloves in taking out the piece, wave it in the air a few times to cool the surface and prevent marring, and then bend to shape with your hands.

Jigs. The plastic tends to spring back as it cools, but a wooden jig will serve to hold



Heated in an oven, a $5\frac{1}{2}$ " length of plastic is bent by hand for the curved piece in the cigarette box shown on the facing page. One or more long jigs, as above, speed work when several boxes are made.

Wet sanding, with the wet paper on a flat surface as below, and then buffing will polish the edges of the curved piece. The ends to be cemented will look opaque, but make no attempt to polish them.



it in shape while it sets. For a single curve, a flat piece with two raised edges is sufficient. The ends are held by the raised edges, as in one of the photos, and the work assumes a graceful, natural curve. Double and more intricate curves are formed in cutouts, as shown in the jig for the candlestick on page 132. Cut the shape out of the board and discard it; then bend the hot plastic and fit it into the frame. Soft pine sanded smooth is best for a jig. Hardwood may leave jig marks.

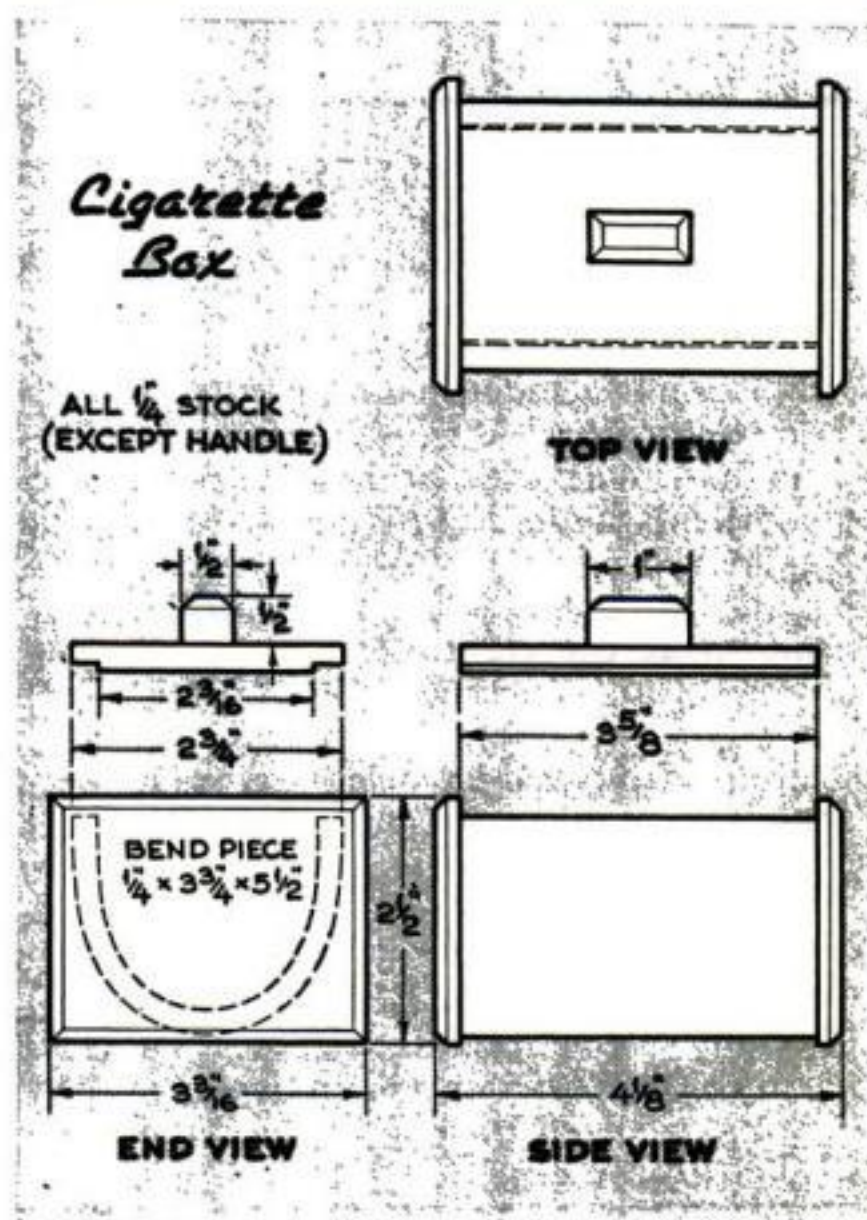
Grinding. An edge or bend that is to be cemented should first be ground or sanded to assure a true, flat surface for a good fit. Rabbits can be made on a grinding or sanding wheel lowered to project but slightly above the table. Several light cuts rather than one heavy one are best for a heavy grinding job, as too much heat causes "crazing."

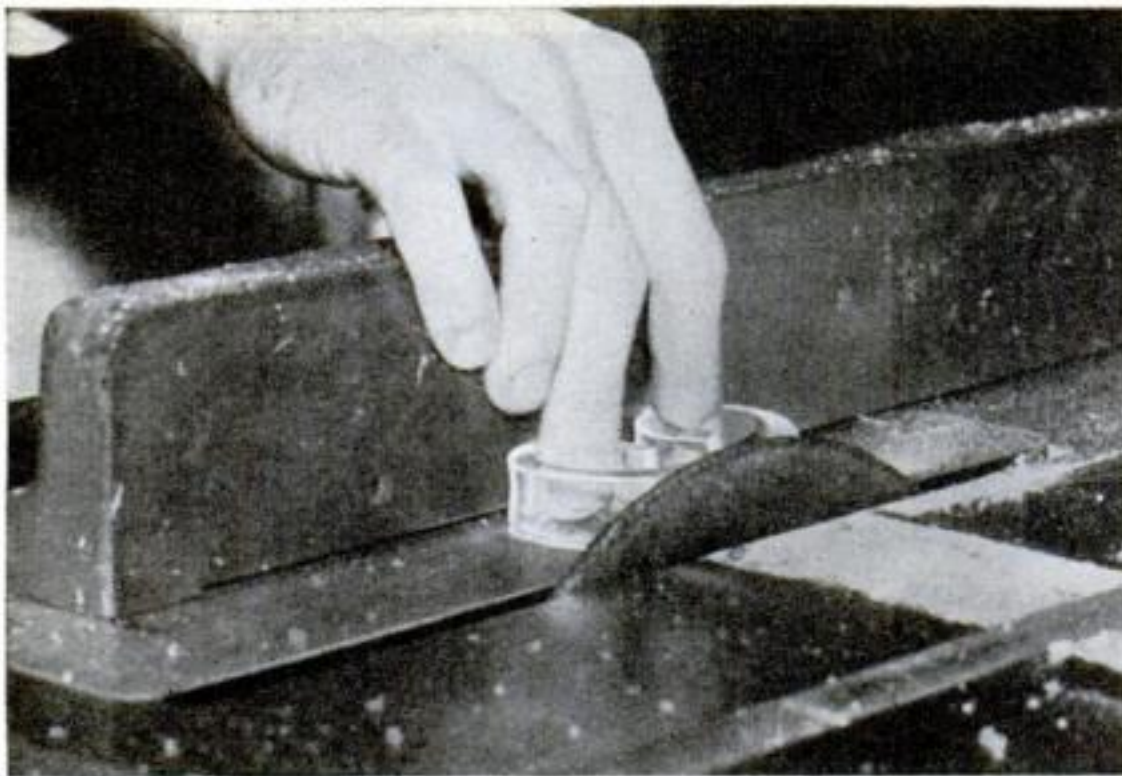
Cementing. The best cement is the plastic itself in monomer form before polymerization. A thicker cement, particularly useful for filling inaccurately fitted joints, can be made by adding shavings of the plastic to ethylene dichloride. Be careful not to breathe the fumes. Fairly good cementing



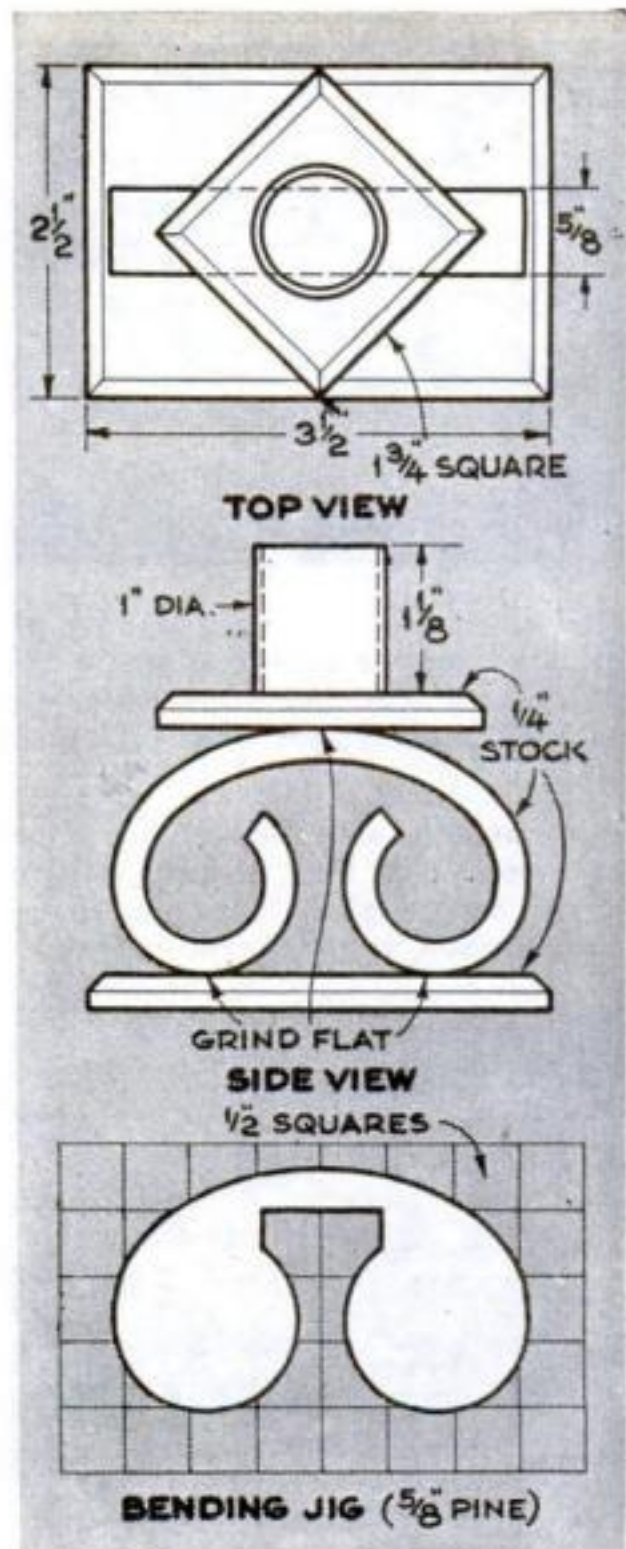
Working the ends of the curved piece on a sanding disk or belt or a grinding wheel trues them for cementing. A resinoid-bonded aluminum oxide wheel is being used above. Leave the ends unpolished.

Cement clears up the opaque ends. Apply it with a brush to one end, as below, let it dry, and then cement the other end. Dimensions for making the box and a lid are given at the bottom of the page.





After bending an $8\frac{1}{2}$ " length of plastic in a cutout jig (right), flatten the bottom curves for cementing; then reverse the piece, holding the bottom on a parallel fence to flatten the top curve. The grinding disk shown here is mounted on a circular-saw arbor.



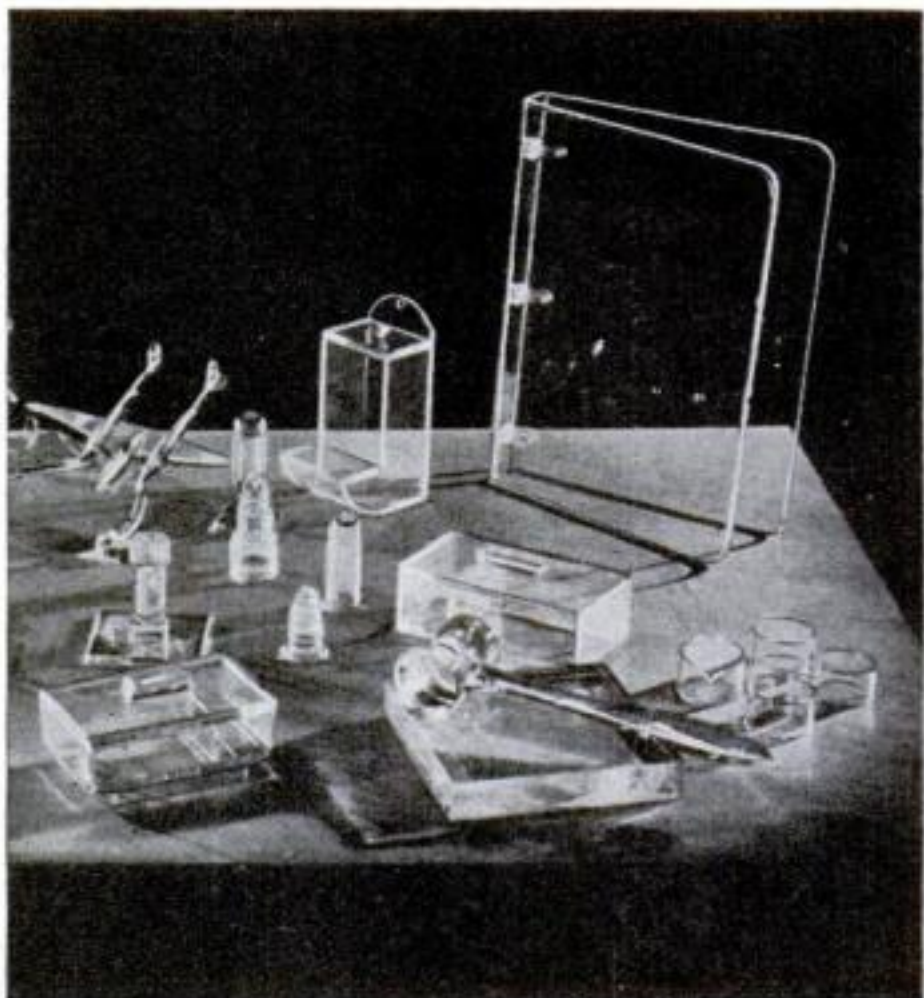
can also be done with acetone or glacial acetic acid.

If the surfaces are true and flat, the cement will run through the joint evenly and the joint will be clear, but surfaces that do not fit may remain opaque. Apply the cement with a small water-color brush, touching the joint at several places and letting the cement flow in. Wipe excess off at once. No clamping is necessary unless the joint is exceptionally large.

Dyeing. Both "cold-dip" and "hot-dip" dyeing with an aniline dye in a liquid carrier are possible. Bracelets and similar small articles are in general the easiest to color by home dyeing methods.

MODELING IN PLASTICS has been taken up by the Army, but it's a postbattle course instead of a pre-battle one. The first Army classes, composed of soldiers and Wacs who will teach occupational therapy to convalescent veterans, are being conducted at the Ordnance School at the Aberdeen Proving Ground in Maryland. Some of the articles made by these student-teachers are shown at the right.

Besides constructing personal and household articles, students get an introduction to designing aids for engineering training. The course includes lathe, milling-machine, and drill-press techniques and plastic fabrication, coloring, and cementing. It will help wounded men regain use of their arms through muscle movement and also teach them a trade.





FIRST PRIZE. Clever design and expert artistry made this intriguing bracelet by Charles Morgan the outstanding entry.

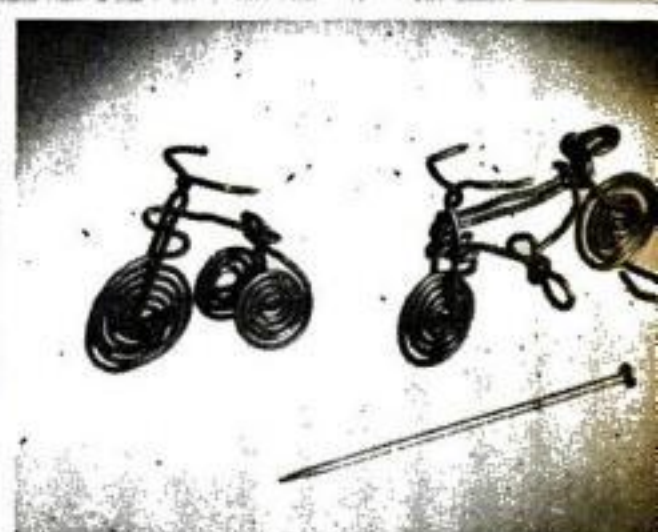
Tied for second were Mrs. J. Austin Wickum's wire cat and T. Mynick's bracelet shown below.

Announcing the Winners of Our WIRE CONTEST

SO MANY excellent projects were submitted in the POPULAR SCIENCE contest for things made of wire that the judges were forced to award a record number of ties. The first-prize entry was outstanding for the \$25, but two placed second for \$15 each, five were third for \$5 each, and eight \$1 prizes were given instead of five for a total of \$88 instead of the original \$50 offered. Six of the most photogenic entries are shown here.

LIST OF WINNERS

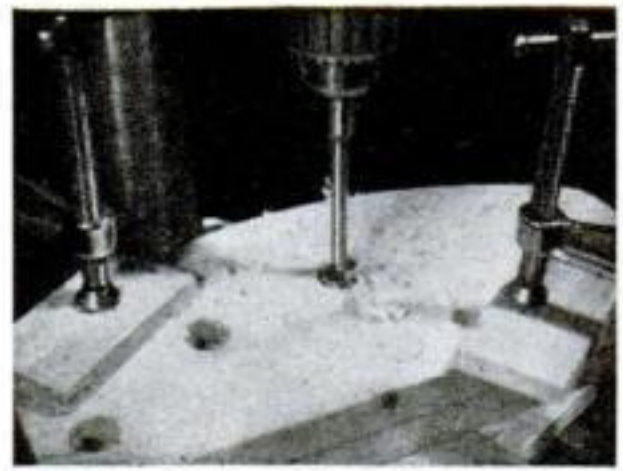
- 1st Prize: Charles Morgan, Philadelphia.
 2nd Prize: Mrs. J. Austin Wickum, Chicago.
 T. Mynick, Ashley, Pa.
 3rd Prize: L. A. C. Facey, R.C.A.F., Goose Bay, Lab.
 Frank T. Erzen, Cleveland.
 Steve A. Sutch, Fairport Harbor, Ohio.
 O. C. Kuehn, St. Louis.
 F. G. Gilbert, Barin Field, Pensacola.
 Honorable Mention: James F. O'Brien, Toledo.
 George Sabula, F.P.O., New York.
 Miss Marjorie Hoover, Mansfield, Ohio.
 Raymond S. Brown, Columbus, Ind.
 Lloyd McCleskey, Alamogordo, N. Mex.
 Robert Scott, Saltsburg, Pa.
 G. Hamlin Leonard, Mount Ranier, Md.
 Carroll S. Weller, Richland Center, Wis.



O. C. Kuehn's candlestick (left) was among five ties for third prize. James F. O'Brien won an honorable mention with his cycles, shown above next to a pin.

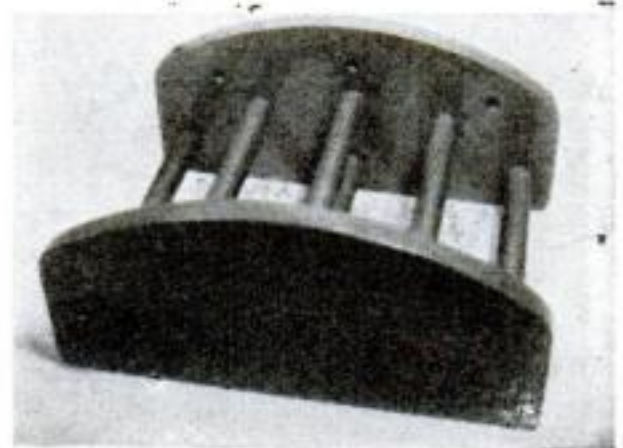
And another in third place was L. A. C. Facey's bracelet.





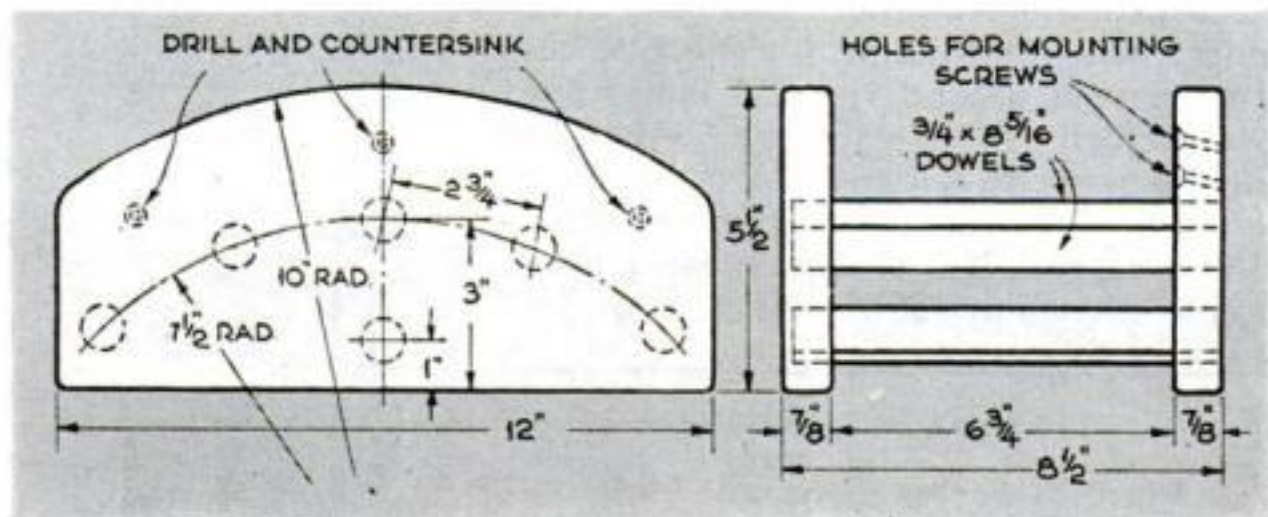
Clamp the two rack sides and drill dowel holes in both simultaneously.

Below is the completed holder. It will keep the hose neatly coiled.



GARDEN HOSE RACK

PROPERLY built, this rack will easily support a 50' hose and should last for years. A pattern cut from cardboard will help you outline the front and back on $\frac{7}{8}$ " or 1" hardwood. If the dowel holes are drilled with a Forstner bit, about $\frac{3}{16}$ " of wood can be left on the front to provide a smooth face. Drill and countersink holes in the back for fastening the rack to the wall. Use waterproof glue for the dowels and dry overnight under pressure. To attach the rack to stucco, concrete, or bricks, make holes in the wall with a star drill and plug them with dowels to hold the screws. Or, if you wish, metal expansion plugs or screw anchors can be used.—W. T.

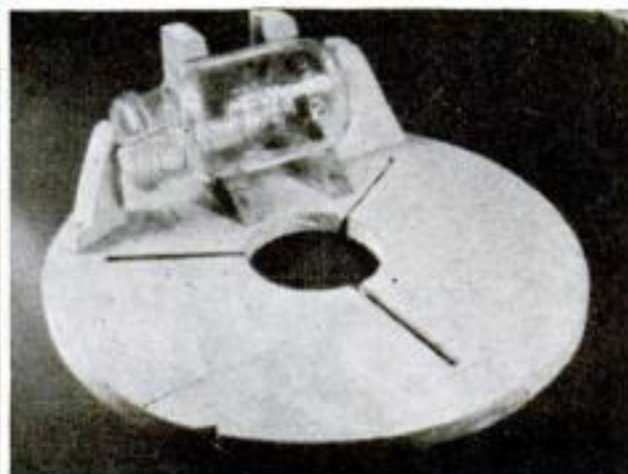


Need Butter? You Can Churn Your Own in a Washing Machine!

PROVIDED that cream is available, a washing machine offers the opportunity of keeping a family supplied with butter. A wooden adaptor jig, easily made by anyone who is handy with tools, will do the churning in short order. From $\frac{3}{4}$ " or 1" stock cut a circular base with a diameter slightly less

than that of the washing machine. If a single piece of sufficient width is unavailable, glue two or more together and plane them smooth. Cut a large center hole and three radial slots to permit the base to drop over the stem and fins of the agitator. Near one edge of the base, attach two identical

wooden blocks in which you have made semi-circular notches to accommodate a quart jar. Blocks held by a single bolt so that they will swing aside clamp the jar in place. Fill the jar with cream, place it on the jig, and the agitator will do the rest.—JOSEPH GOULART.



Croquet Tips

HOW has your croquet game been this summer? Frequent use may have loosened the handles in your mallet heads, earlier sunset may be shortening your play, or you may find it tedious to lay out the ground each time you play or dangerous to leave the wickets where someone may trip over them.

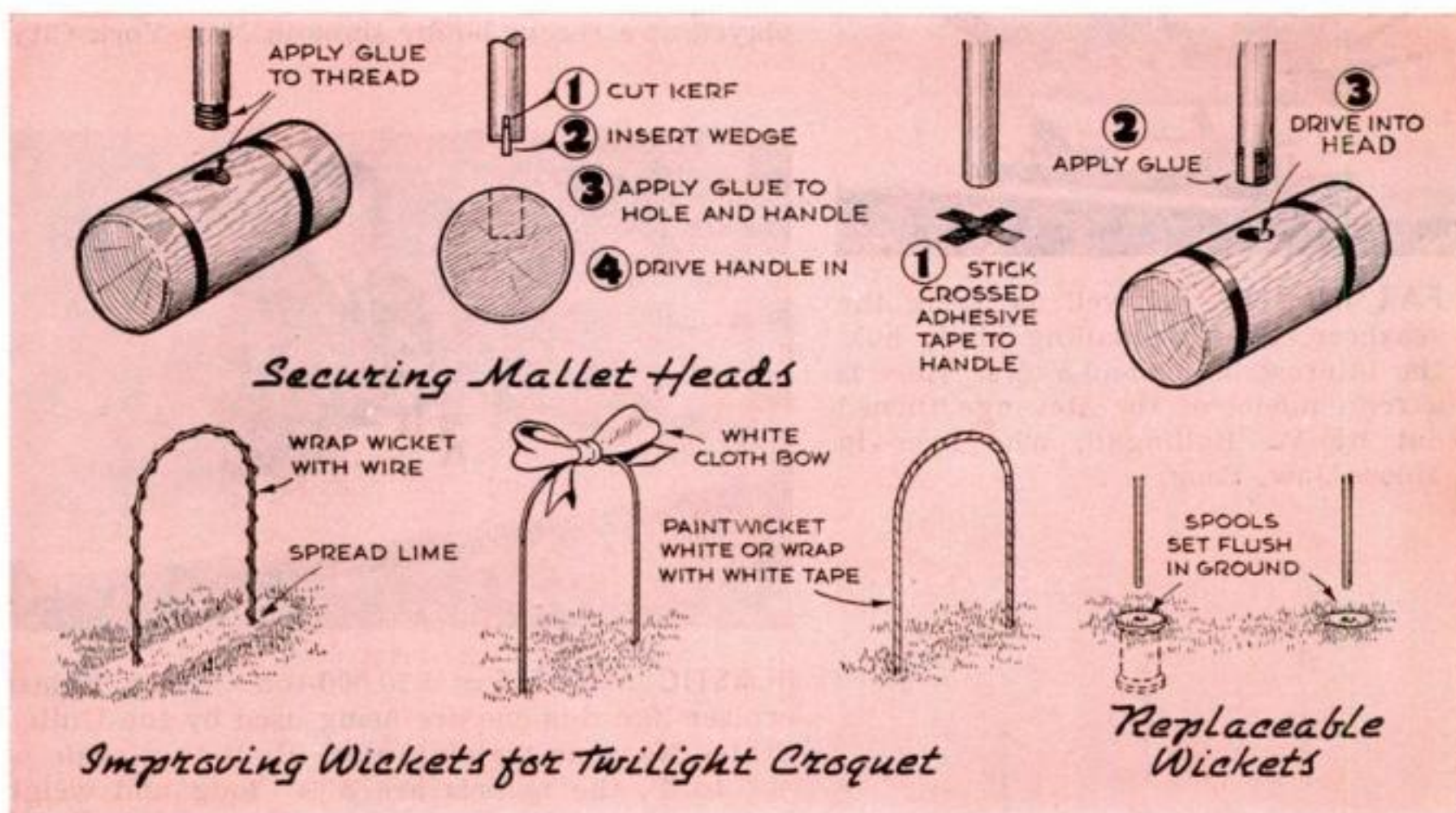
Loose mallet heads will hold with glue if they are threaded. Others can be held tight by cutting a saw kerf in the handle, inserting a wooden wedge, applying glue, and driving the handle in. The wedge spreads the handle so it will hold. Another method is to apply crossed adhesive tape to the end of the handle and follow with glue.

Visibility can be improved when shadows



deepen with wrapped wire to make the wickets larger, a stripe of lime, a white bow tied at top, white paint, or white tape wrapped around the wickets.

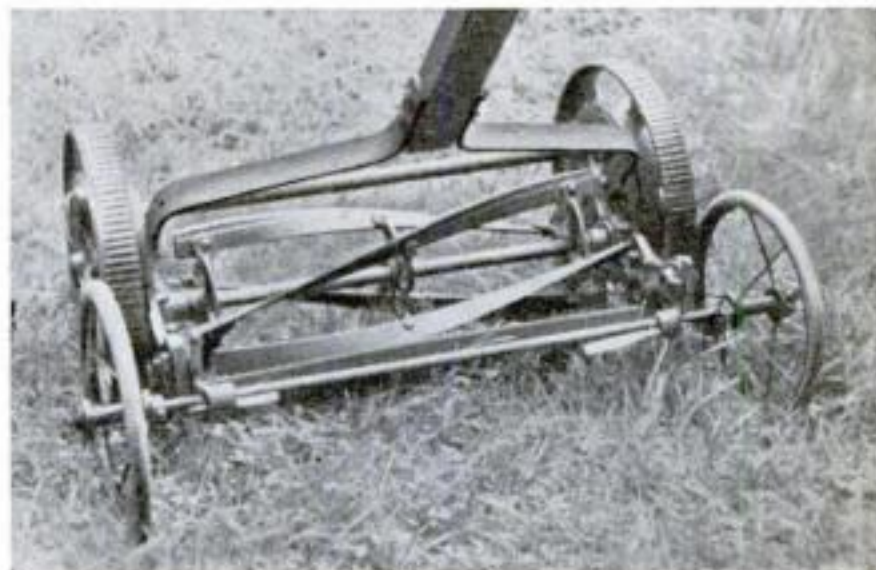
Those who like to have the ground laid out accurately might try setting spools in flush. Wickets can then be replaced with no further measuring.—K. H. MATHUS.



Auxiliary Wheels Raise Lawn-Mower Blades to Cut High Grass

WHEN grass has been allowed to grow too long to be handled with an ordinary lawn mower, the cutter blades can be raised by substituting a pair of 8" wheels from a discarded baby carriage for the conventional roller.

For an axle, a $\frac{3}{8}$ " rod threaded at both ends is wedged as shown in the roller-axle bearings. Setscrew-held collars inside the wheels and nuts and washers outside keep the wheels in place. Lower the handle, if desired, by removing one bolt and drilling a new hole.—CHARLES BARR.



CRAFT FROM TABLE-TOP SHIPYARDS



FAR INLAND, as well as along the seashore, old-time sailing ships hold the interest of modelmakers. Here is a trim model of the *Revenge* turned out by W. Ballingall, who lives in Moose Jaw, Sask.

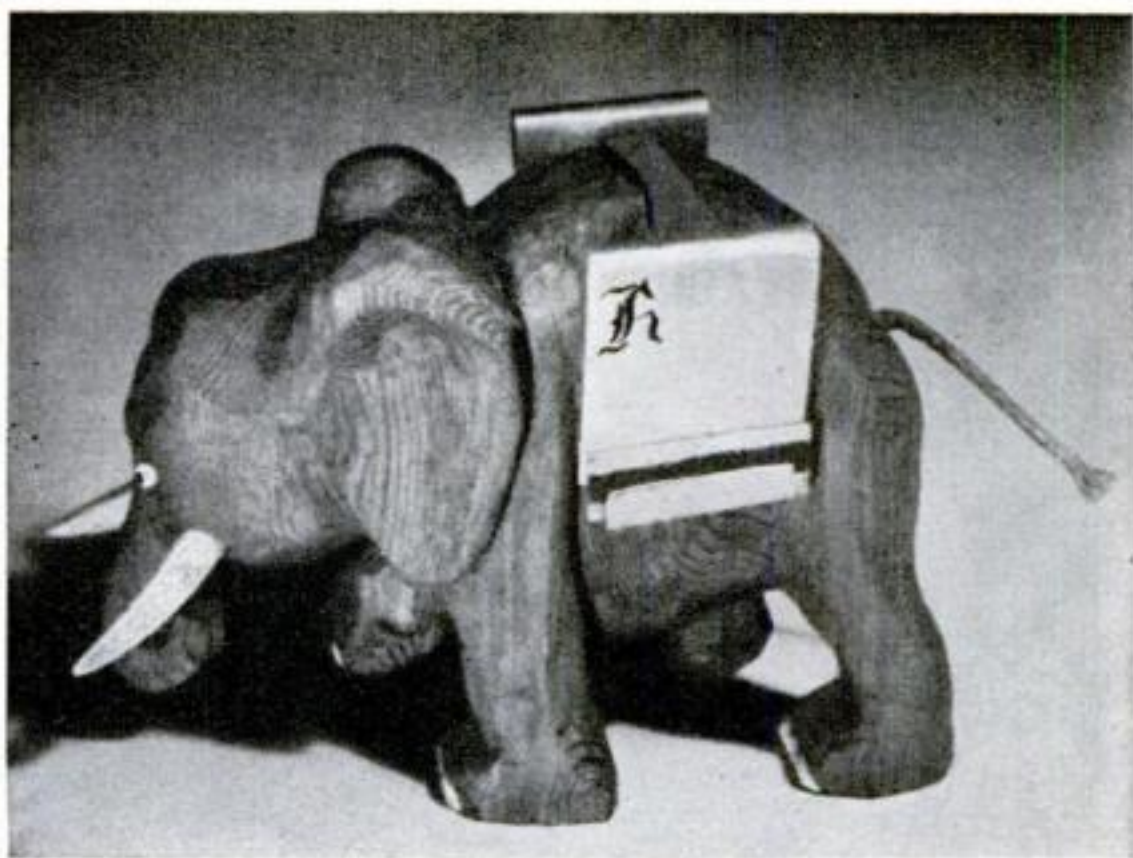
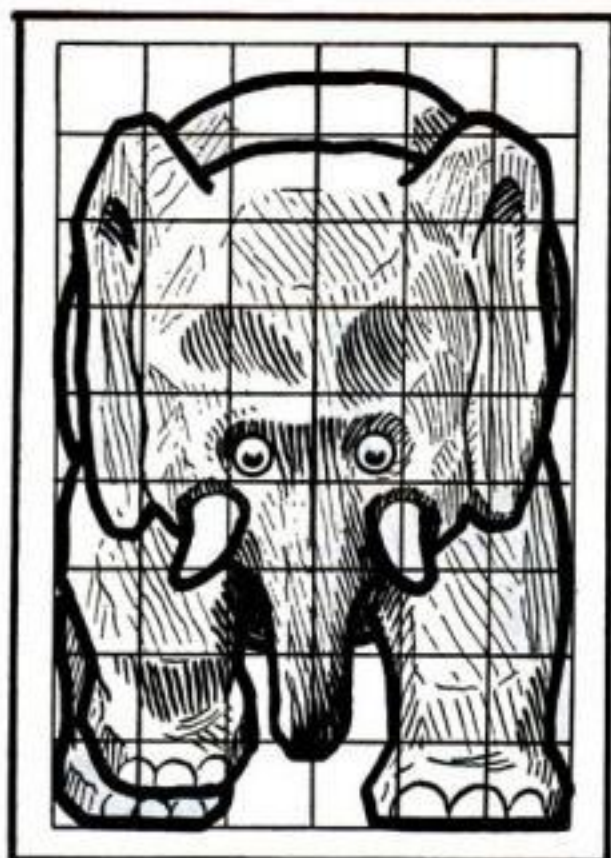


FORTY-FIVE SAILS gave a lot of speed to the five-masted, full-rigged clipper ship *Preussen*. Olaf Jordan, at left above, explains the fine points of the model, on the making of which he spent most of his spare time for six years. It was displayed at a recent hobby show in New York City.



PLASTIC MODELS of a 10,000-ton, Cleveland class cruiser like this one are being used by the United States Navy as training aids. Built to a scale of $\frac{1}{8}$ " to 1', the models are 6' 4" long and weigh 8 lb., 6 oz. Each ship requires nearly 1,000 parts, made with 40 dies by injection molding of cellulose acetate. Whenever possible, structures are molded as complete units, much as their prototypes are prefabricated in shipyards, and only then mounted on the hull.

← **THE WANDERER.** This neat model of the three-master that sailed out of New Bedford in the days when that famous New England port handled some of the most important shipping in the world was built several years ago by Isaac Henry, of Washington, D. C. Like others on this page, it reveals a high degree of craftsmanship.

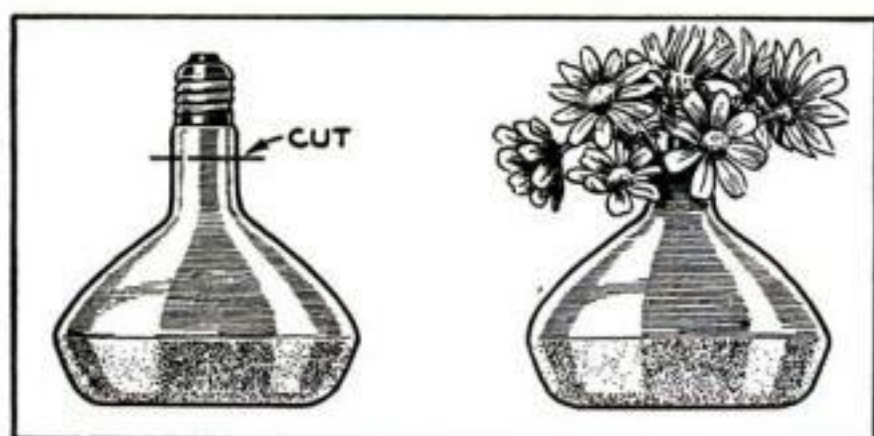
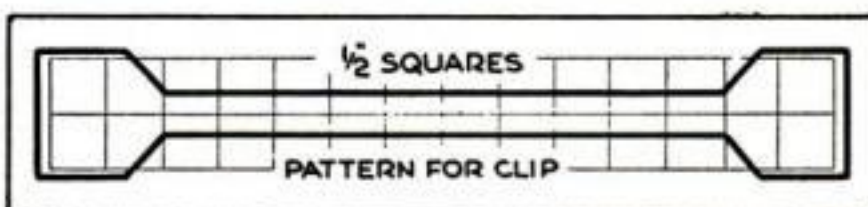
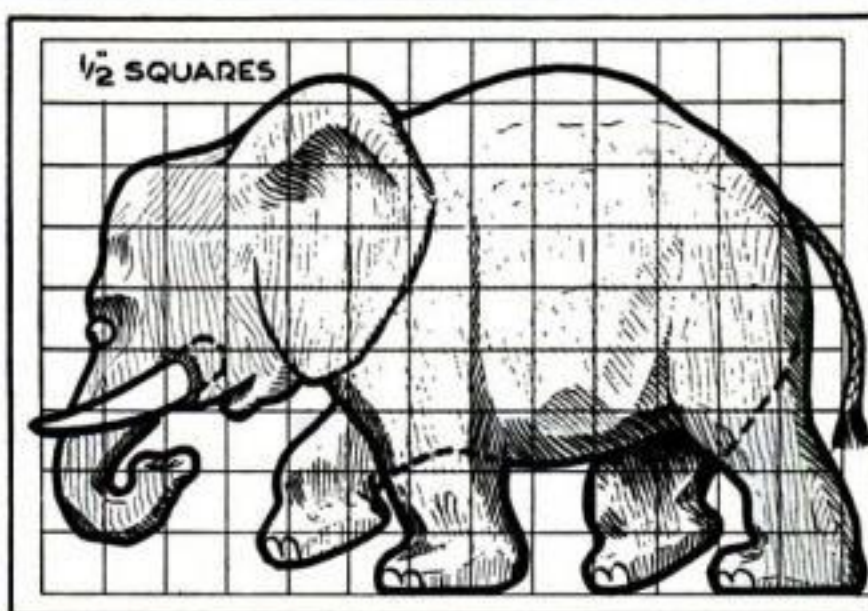


Desk-Top Elephant Will Carry Supply of Book Matches

ESMERALDA is a perky elephant, as appealing as an ornament as she is in her role of supplier of lights. Make her on two blocks, laying out the side with the legs forward on one and that with the legs backward on the other. Saw out and glue the two halves.

Whittle with a jackknife or carving tools, turning the figure often. Glue wood tusks and a cord tail in drilled holes. Paint body and tail gray with black in the creases, tusks and toenails white, and mouth red. White map pins with black spots form eyes.

The clip is tin-can stock bent up $\frac{1}{2}$ " at the ends. Brad it on.—ELMA WALTNER.

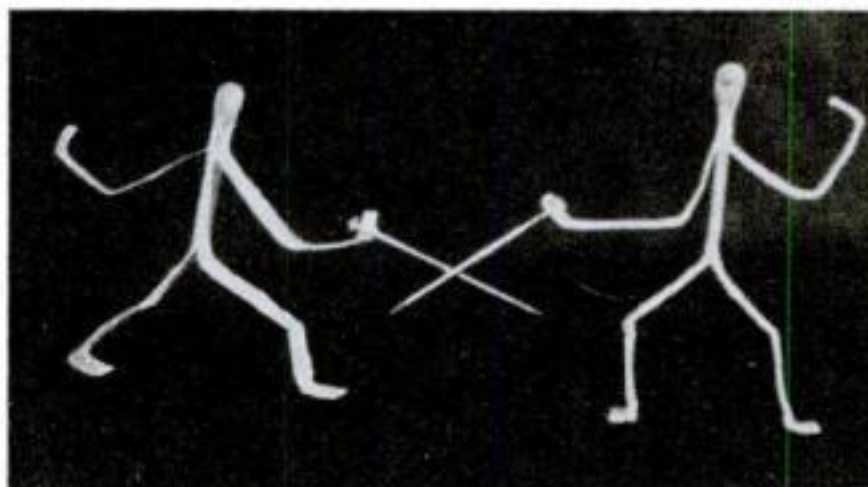


Light Bulb of Reflector Type Fashioned into Dainty Vase

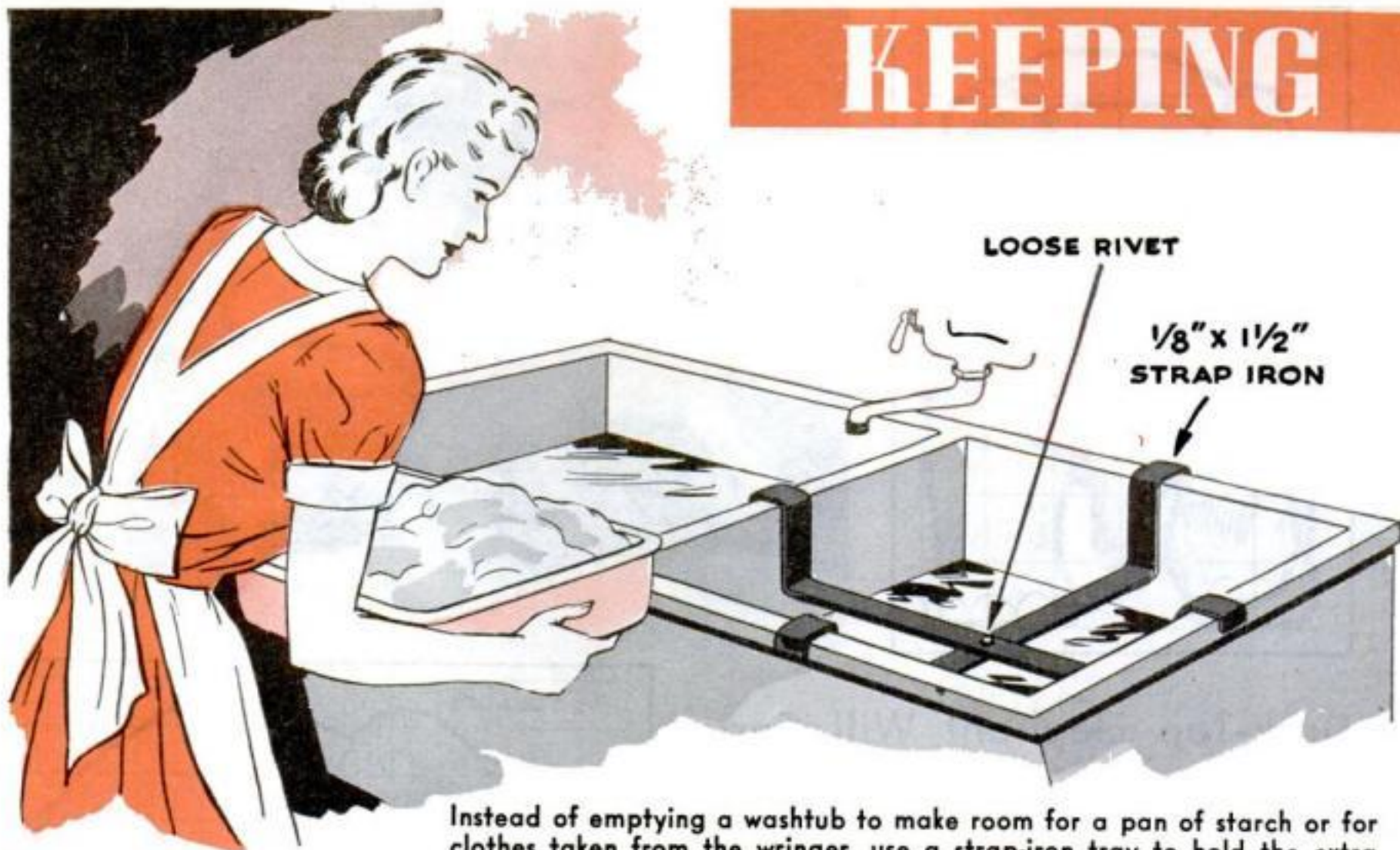
ELECTRIC-LIGHT bulbs with a flat surface, as shown at left, stand without tipping. File around the base, break it off, and file the cut smooth. Water and flowers shouldn't damage the silvered inside if the surface isn't scratched by the stems.—RALPH S. WILKES.

Fencers Made of Paper Matches Handle Pin Foils with Vigor

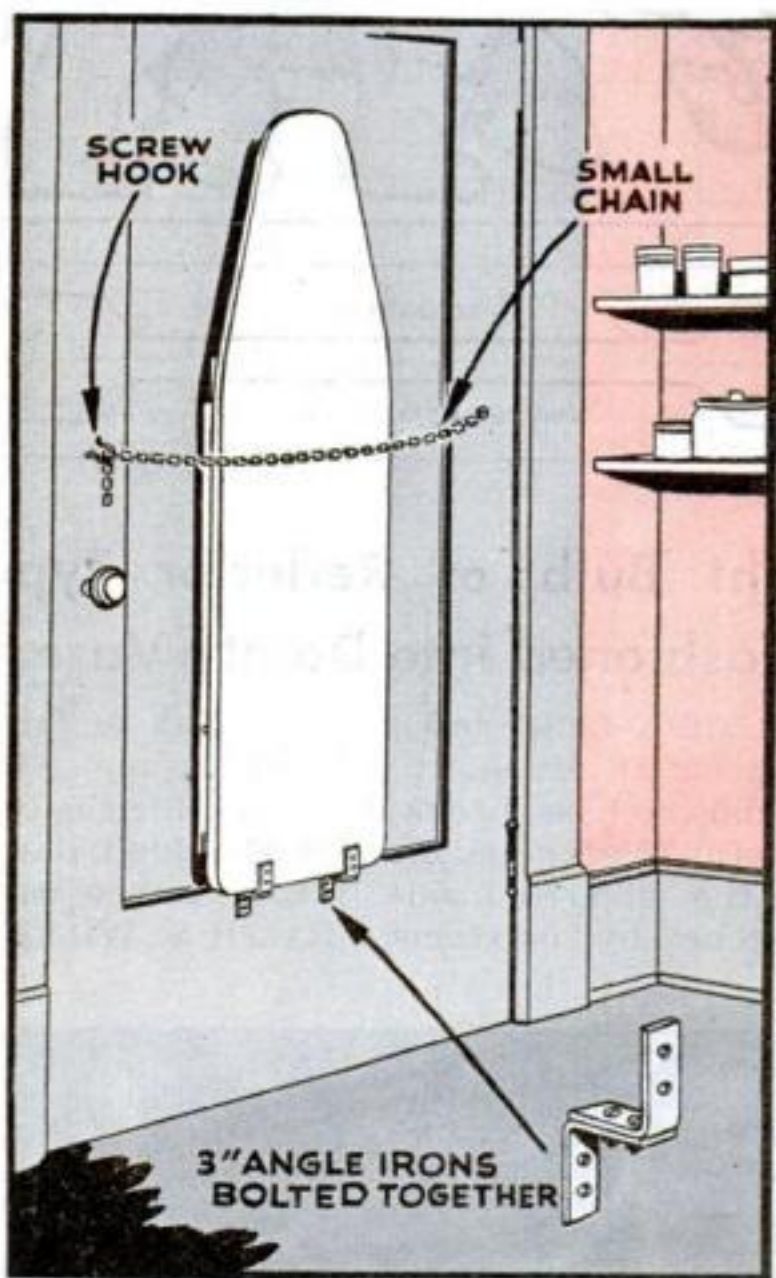
EACH of the figures shown at right is made from a single paper match split into four plies with a razor blade. Bend the plies up to represent arms and legs. Pins stuck through the forward hands serve as foils. A spot of glue will hold the feet to a card.—RONALD EYRICH.



KEEPING

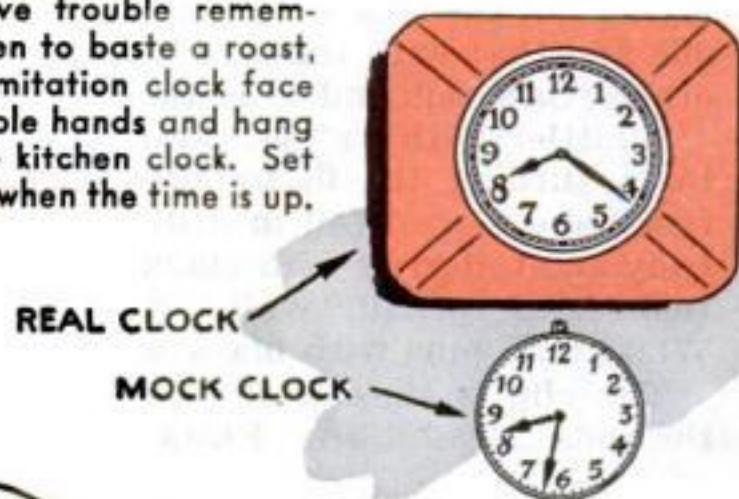


Instead of emptying a washtub to make room for a pan of starch or for clothes taken from the wringer, use a strap-iron tray to hold the extra pan or basket. Bend two lengths of iron as shown and rivet them loosely at the center so that the cross can be folded or used on an oval tub.



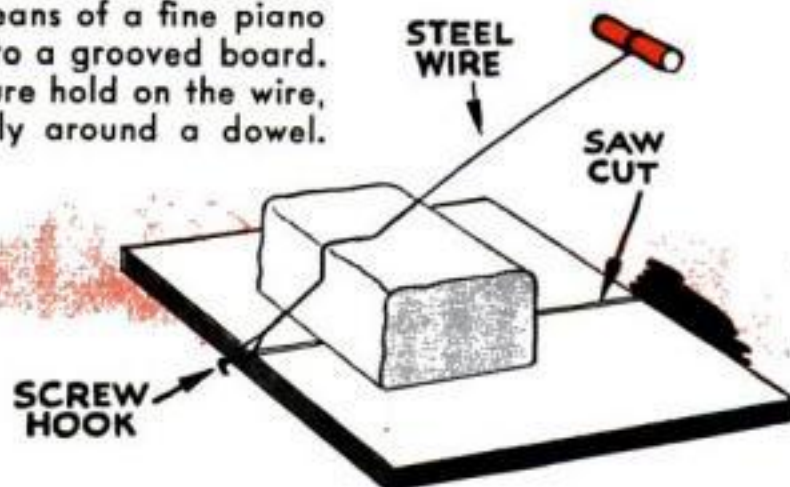
Ironing boards that fall out of closets or unfold at awkward moments can be held in place by angle irons bolted together as shown and then screwed to a door. Hook a chain across above.

If you have trouble remembering when to baste a roast, make an imitation clock face with movable hands and hang it near the kitchen clock. Set it to show when the time is up.

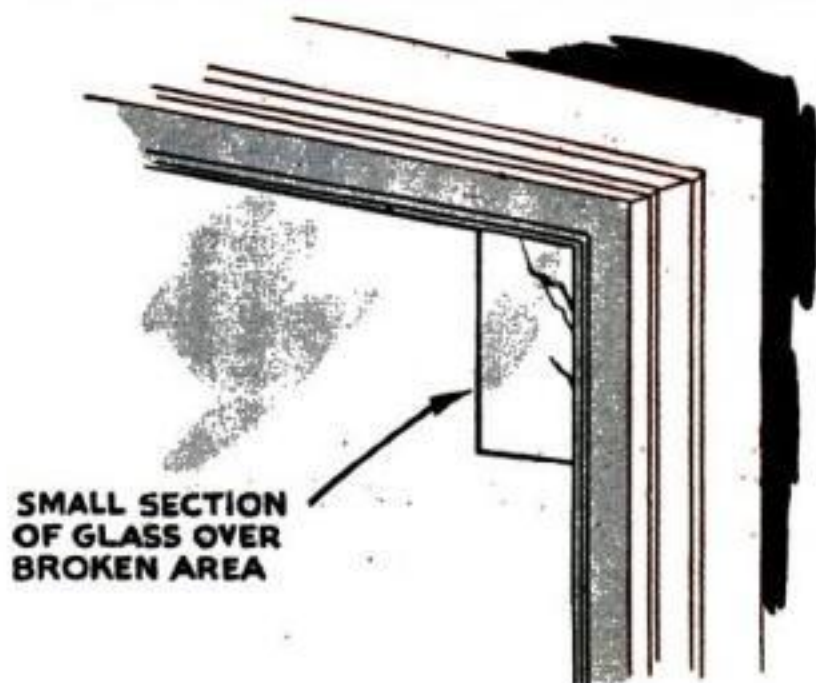


Wax seals on home preserves can be removed smoothly and without danger of chipping into the jelly if stiff paper tabs are placed in the molten paraffin when the jars are sealed.

Heavy cheeses that tend to stick to a knife can be cut evenly and quickly by means of a fine piano wire hooked to a grooved board. To get a secure hold on the wire, twist it tightly around a dowel.

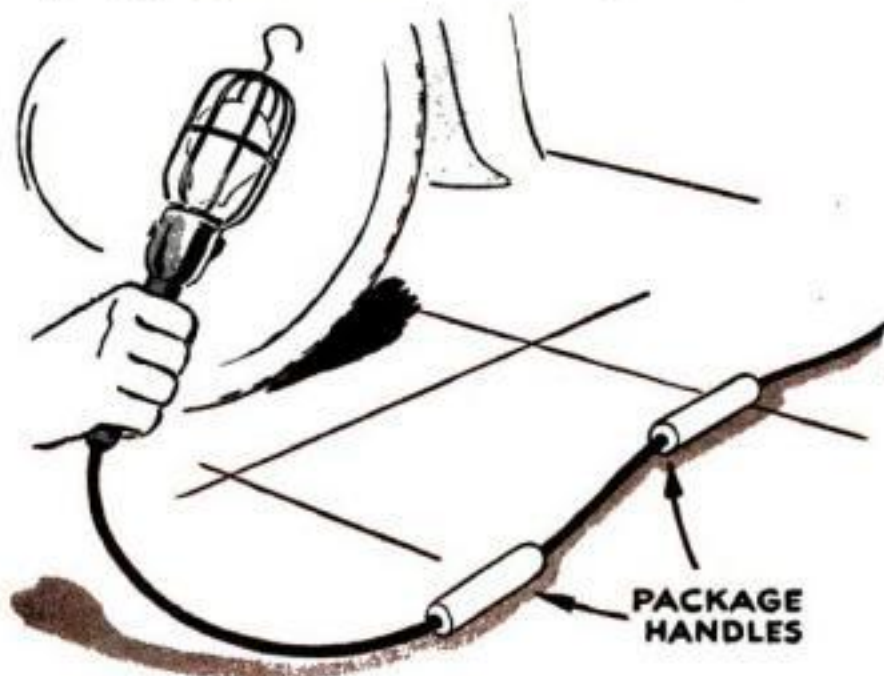


THE HOME SHIPSHAPE



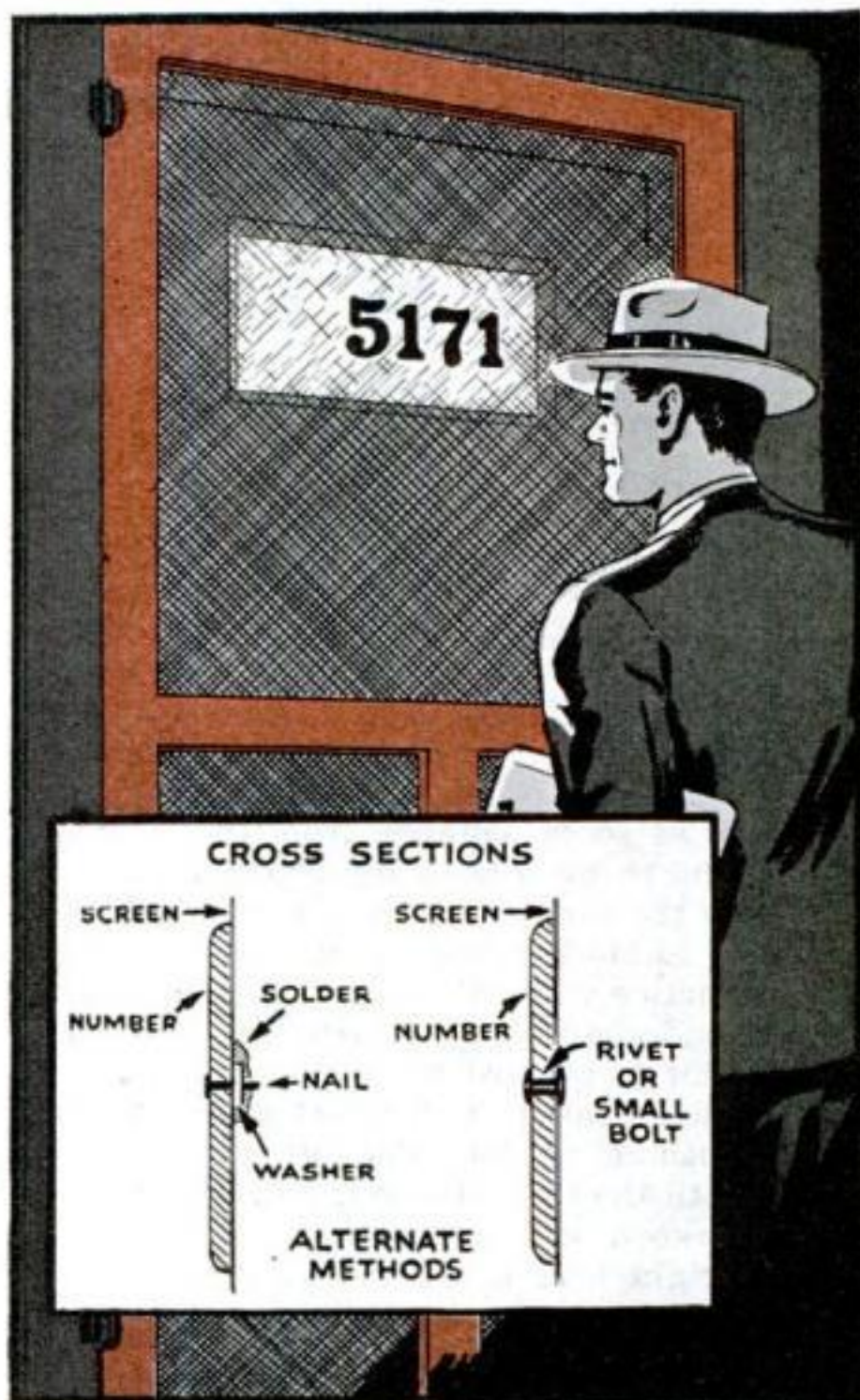
SMALL SECTION OF GLASS OVER BROKEN AREA

To make temporary window repairs without using ugly cardboard patches, place a piece of glass over the broken section and fasten it in position by applying clear modelmakers' airplane cement.

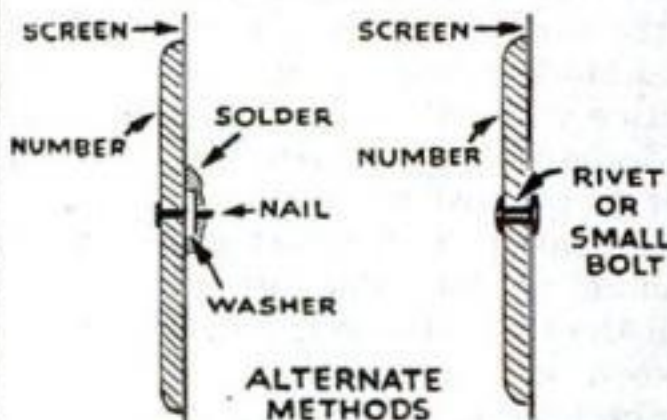


PACKAGE HANDLES

To save wear on extension cords pulled about over the rough surface of a garage or cellar floor, minimize contact with the floor by slipping package handles over the wire at intervals of a few feet.

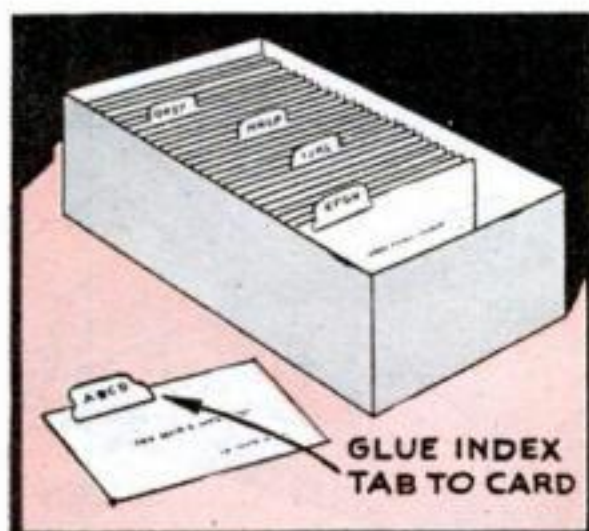


CROSS SECTIONS



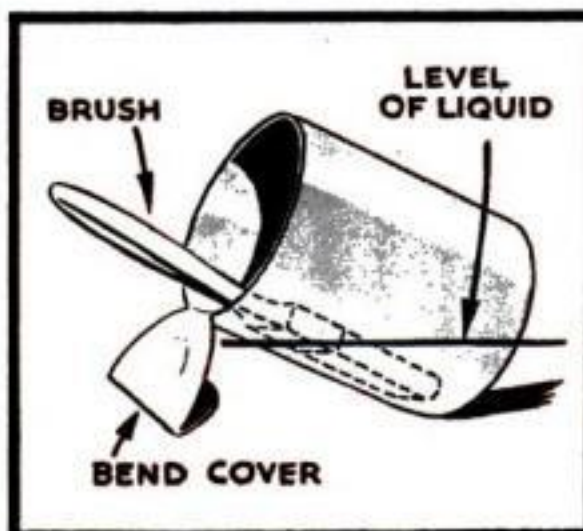
House numbers can be made visible at night without special lighting by attaching ordinary numerals to the screen door. Place them so that they will be silhouetted against light shining from within.

Calling cards that become obsolete because of a change of address can be converted into a filing system for recording recipes and the like. Use the original box.



GLUE INDEX TAB TO CARD

To protect a paintbrush between coats, stand it in a tin can set at an angle. Very little fluid is needed to cover the brush and it does not settle on its bristles.

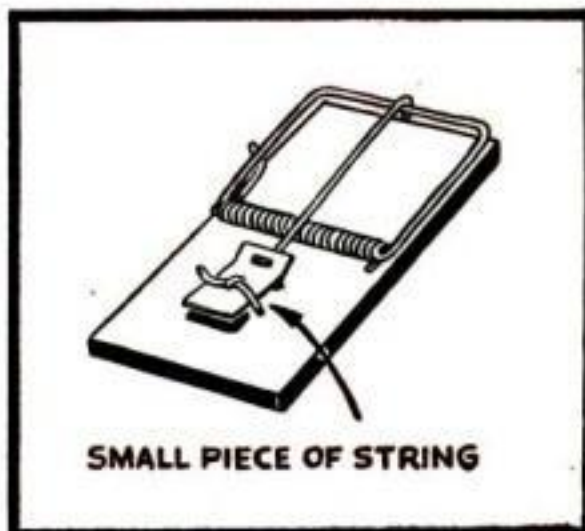


BRUSH

LEVEL OF LIQUID

BEND COVER

If rodents are using your traps as free-lunch stands, tie a piece of cheese-coated cord under the bait hook. They won't be able to dine without tripping the trigger.



SMALL PIECE OF STRING

Dust off those old beanbags
and try out your throwing arm!

WHIRLIGIG BEANBAG GAME

By Myron Fleishman

ALL the family will engage in this game, no matter how many of the members have outgrown ordinary beanbags. The whirligig board shown below provides a thrill in testing both the accuracy of your throwing and your judgment in choosing a target.

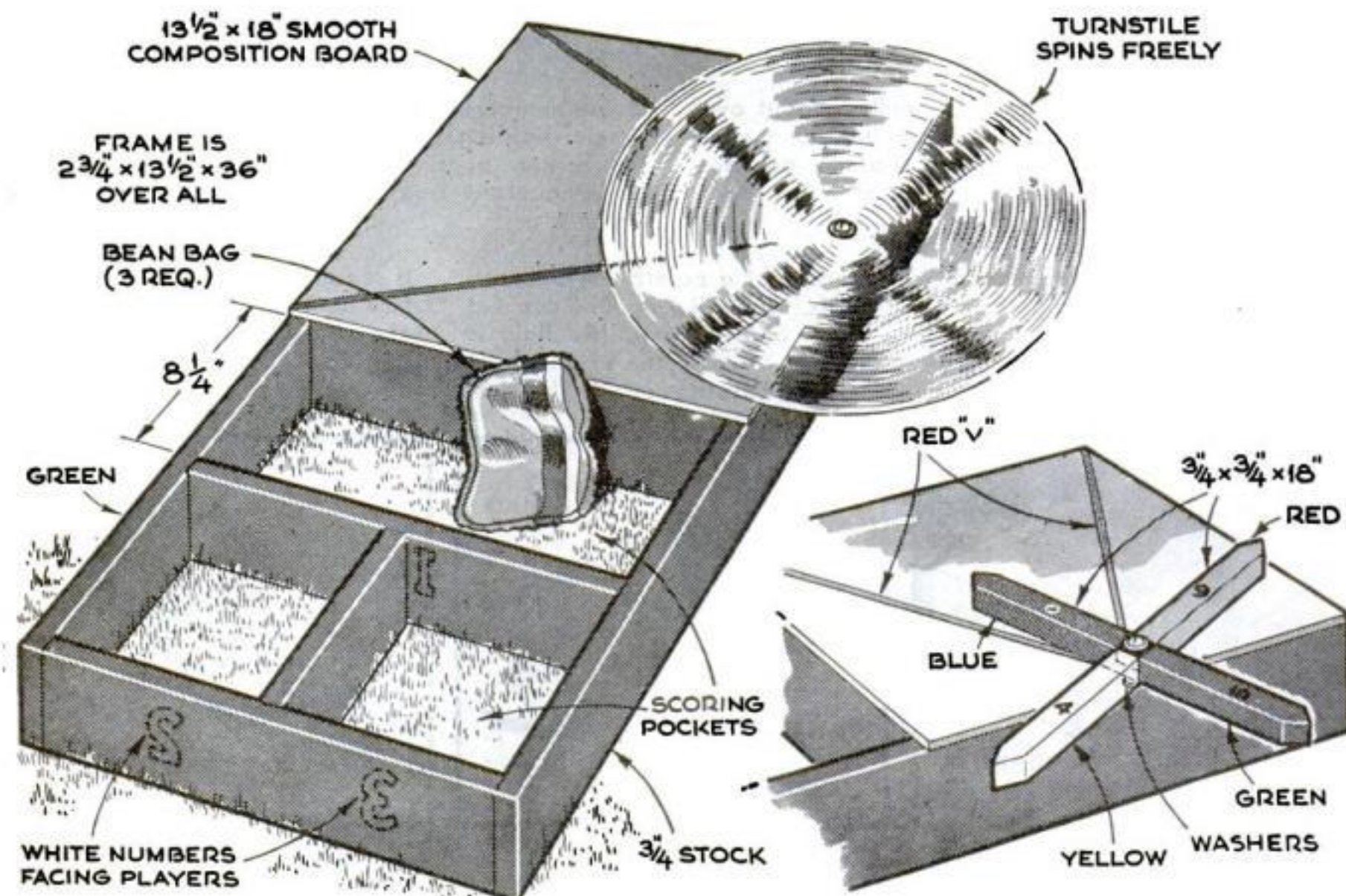
Stand at some distance from the scoring board and throw a beanbag at it in an effort to make the turnstile spin and also to cause the bag to land in one of the scoring pockets. Practice will tell you whether an overhand, underhand, or sidearm toss is best. If you hit the board so the beanbag slides on it, the turnstile will whirl and the bag will continue on into one of the pockets. Wait until the turnstile comes to a halt, and then make a second shot.

And right here is where judgment comes into play. You get three chances to score,



and the number on the turnstile arm that comes to a rest within the red "V" is added to that of the scoring pockets into which you pitch the three beanbags—but you don't add the number on the arm until *after* your third throw. If the red No. 6 arm has stopped in the "V," naturally you will not want the turnstile to spin again and will aim directly for the No. 3 pocket, but if one of the other arms has stopped in the "V," then it's up to you to decide.

A distance of 10' from the board is about right for adults and larger children. Handicaps can be arranged for small children by allowing them closer to the board.



What's Your Ingenuity Quotient?

Have you pulled off a smart one lately? We will pay for each contribution accepted for this page showing ingenious solutions of problems in the home, shop, garage, or camp. It doesn't matter if it's wacky—if it works.

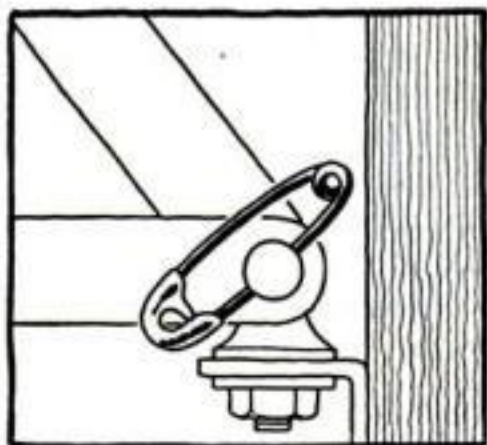


CALLUSES ON MY KNEES and a glimpse of Junior on his kiddy car—then my painting woes were over. No more kneeling on the hard, cruel floor so long as I can cover the expanse with my brush while sitting. I have also tried it on a flat roof, but not a sloping one.—GEORGE A. STRADER.

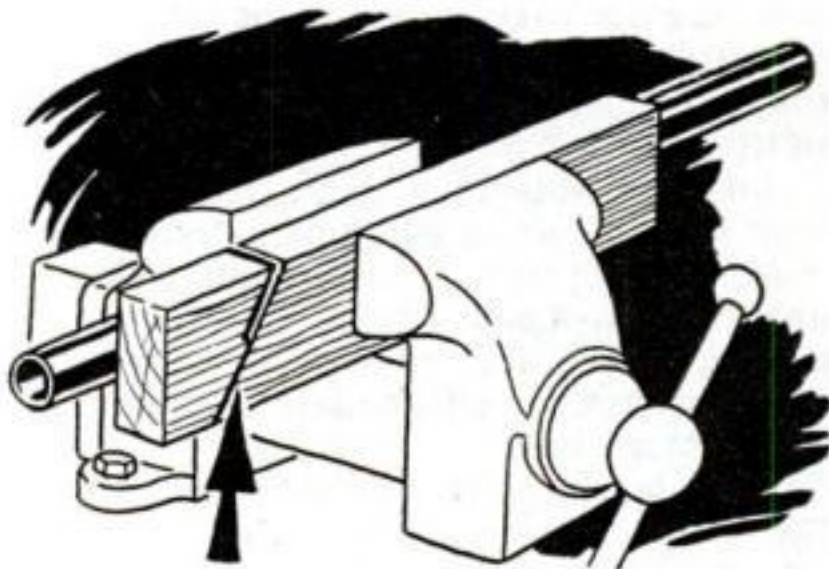
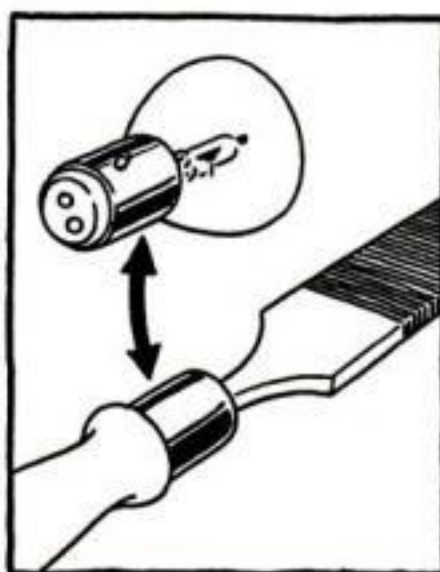
TOBACCO IN MY MOUTH every time I smoked a home-rolled cigarette put a damper on the joy of beating the shortage. I tried a little cotton in the machine, rolling it into one end of a cigarette. Now I smoke without chewing and only worry about lighting the right end.—MRS. FRANKLIN KALBACH.



SAFETY FIRST was the cue when I fumbled while attaching the tack of a mainsail to the gooseneck and, as a result, lost the cotter pin overboard. But I reached quickly for a safety pin, thrust it in place in a trice, and snapped it shut. I have never gone to sea without safety pins since.—JON GILL.



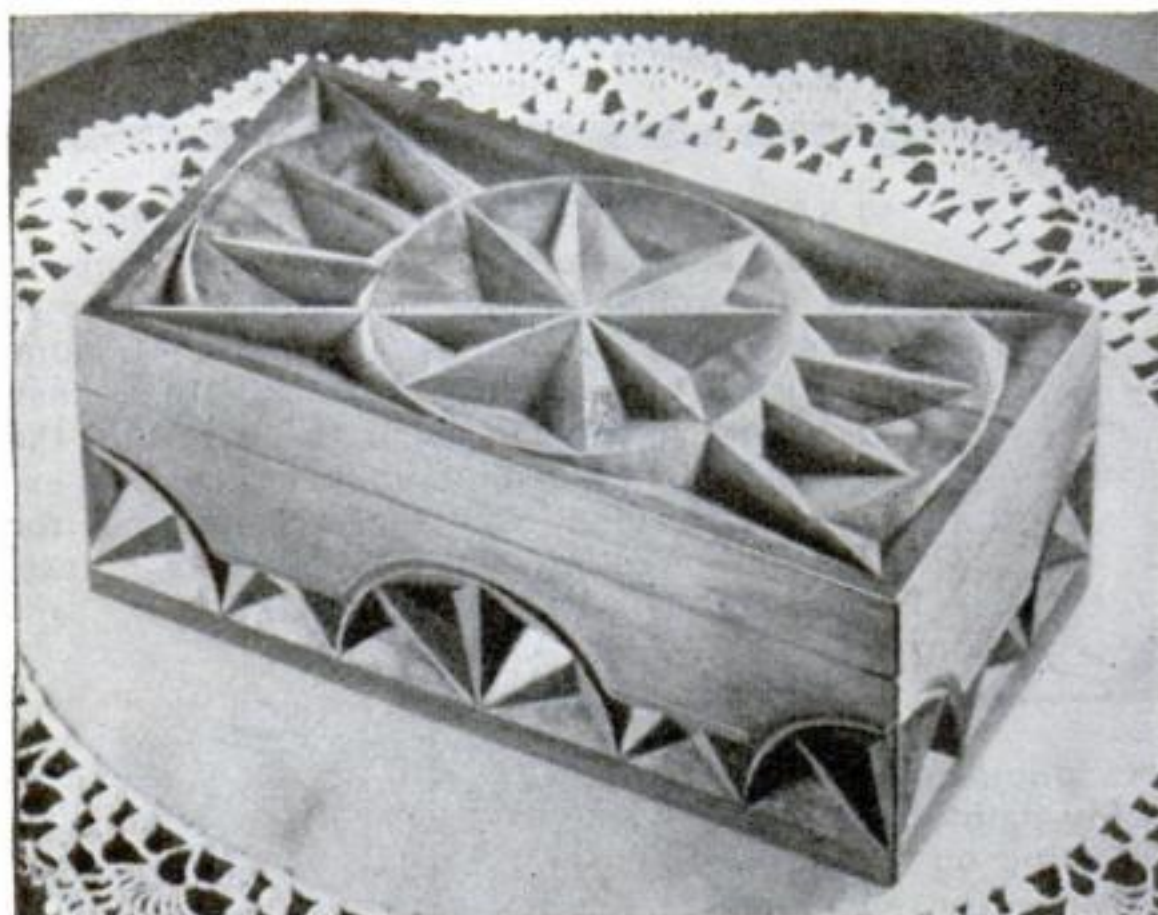
I SAW THE LIGHT when, fitting the tang of a new file into a handle, the ferrule dropped off and rolled I know not where. After 10 minutes on my hands and knees, I came across a burned-out auto bulb. In a flash I had the glass cut from the base and the contact points filed off, and there was an excellent ferrule. Now I use lamp bases for ferrules on all my files, screwdrivers, knives, and chisels.—KENDALL JACKIN.



TEMPER WAS LOST along with a lot of ruined metal tubing when I first tried to saw an accurate bevel for a joint. There seemed no way to lay out the angle until it dawned on me that I could make the hacksaw follow a line drawn on a block of wood with the aid of a protractor. The tubing, clamped in the vise alongside the block, was sawed at precisely the correct angle the very first time.—JOHN KRILL.

BEAUTY THAT'S MORE THAN SKIN DEEP

◆◆CHIP CARVING IS FUN



Intricate designs like this are achieved with a few basic cuts.

By **EDWIN M. LOVE**

REGARDLESS of your artistic abilities, you will find wood carving a fascinating hobby—one in which the results will be well worth your efforts. Designs that work up beautifully can be laid out with nothing more than a compass and a straightedge. The range is vast—from stark simplicity to intricate geometric figures. If you have a knack for sketching as well, it is almost limitless.

Moreover, this ancient craft can be practiced with no more equipment than a knife or a chisel or two, a clamp, and a bench or stout box on which to rest the work. Chip carving is the art reduced to its most elementary form, and incised carving takes hardly more skill.

What is characteristic of chip carving? The basic unit is a three-cornered pocket with triangular sides. Similar pockets are often modified with curves. Basic and modified pockets can be joined in many ways to form designs, some of them quite intricate; but however elaborated, they are carved with a few elementary strokes. Clean surfaces and sharp corners are badges of excellence in the finished work.

Before starting a project, cut two or three practice pockets in scrap wood to get the feel of the tools. You'll soon find that chip carving is both speedy and simple.

Are all woods suitable for carving? Most of the firm-textured woods are suitable, but very hard woods should be avoided. Mahogany, walnut, and red gum are durable and can be carved without difficulty. White pine is rather yielding, yet it carves nicely with keen tools.

What tools are required? A short-bladed skew chisel beveled on both sides like a knife will make all the cuts, but a gouge is handy for concave surfaces. An ordinary chisel is satisfactory for carving large pockets. A skew knife can be made from a flat file ground to an edge and tempered by being laid on a hot iron until a pale straw color shows on the bevel. The blade is then quenched in

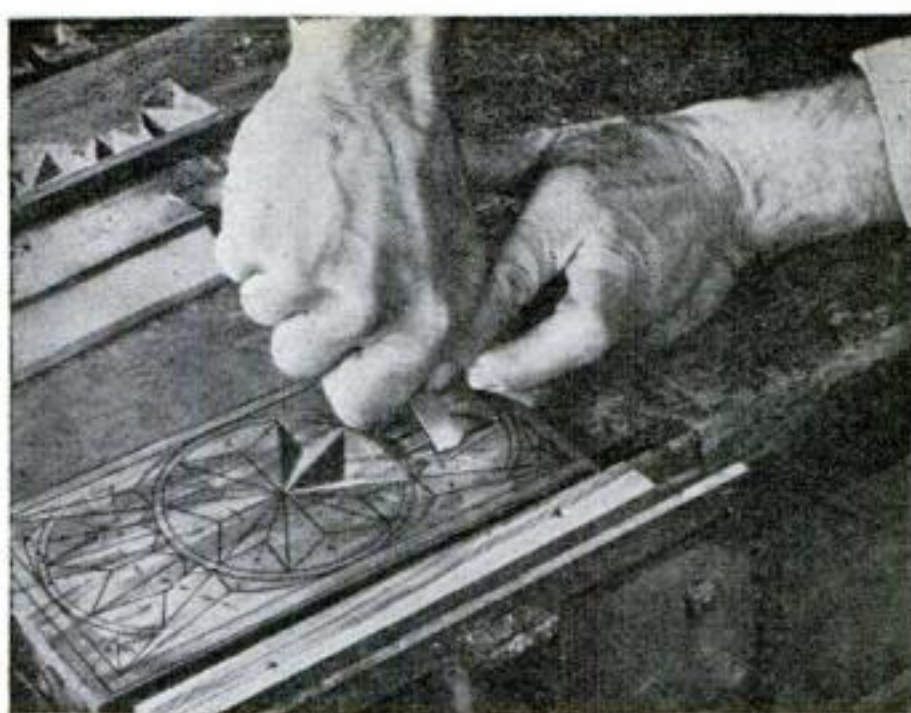
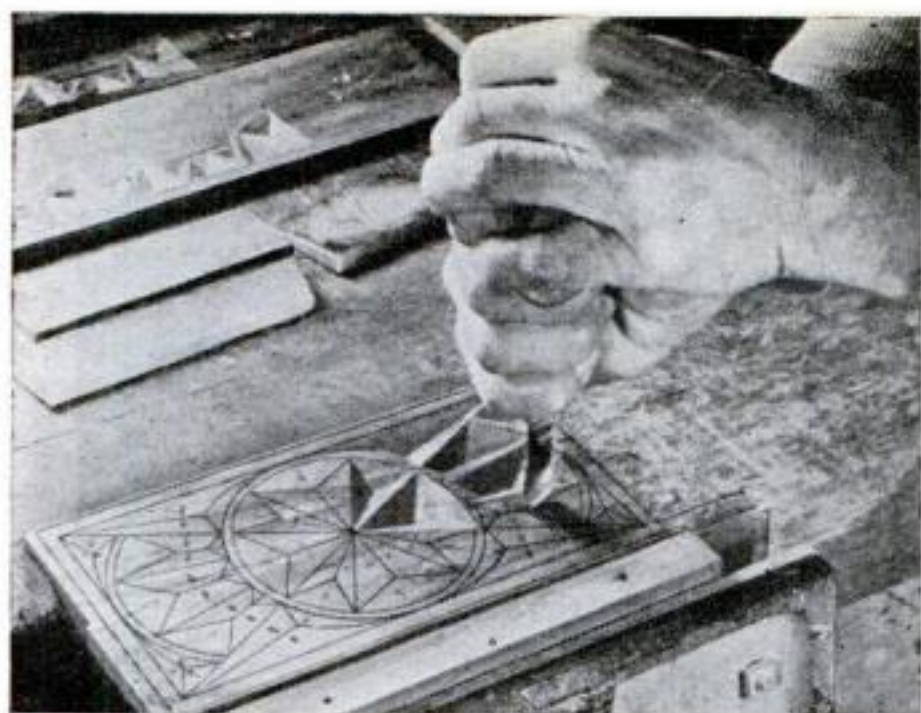
light oil. When finished the edge should be too hard to file.

How is carving started? Mark out the design on the wood or transfer the pattern with carbon paper. You may clamp the piece to the bench; but since it must often be turned end for end, a more convenient method is to work against the bench stop and a piece of wood clamped in the vise.

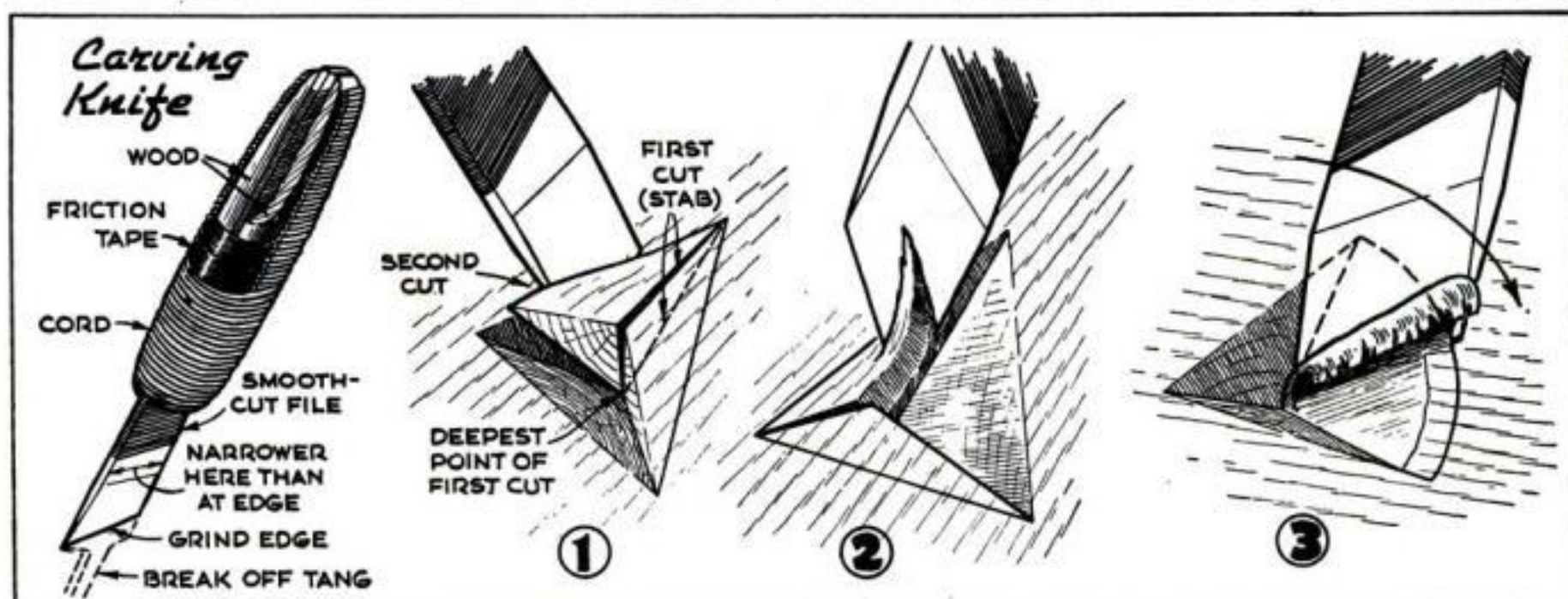
The first act in carving is to "stab" the inside lines of the pocket, making vertical stop cuts to full depth at the center and sloping upward toward the corners. Firm pressure with both hands, combined with edgewise rocking, is sufficient for most cuts, but mallet blows will speed the work when the going is heavy. It may be necessary to deepen a stop cut as the work progresses.

A completed standard cut is shown in Fig. 1. Grasp the knife for the second cut with the right hand, the thumb extended and resting on the work, and start cutting at one end of a side with the under bevel of the blade parallel to the slope. Draw the point along the line, pressing it deeper as it approaches the center and withdrawing it as the triangular chip curls out. By pressing the fingers of the left hand against the right, damaging slips can be guarded against.

When properly handled, a sharp knife cuts a flat, glossy surface. Time is wasted and results are poor if the knife is dull. A strop made by gluing a piece of leather to a block



Two strokes complete a cut in chip carving. The piece is "stabbed," as at the left above, for a stop cut, and then the chip is taken out with a second cut, as at the right and in Fig. 1 below. The left hand is being used in the photo to guard against damage to the work by inadvertent slipping of the knife.



For heavy cutting use a point of the knife and much of the edge, as in Fig. 2 and at left below. A pass removes a large chip and two or three complete a side. Concave sides, a modification of the triangular pocket, are begun with a gouge and then trimmed with a skew knife pivoted as in Fig. 3 and at right below.



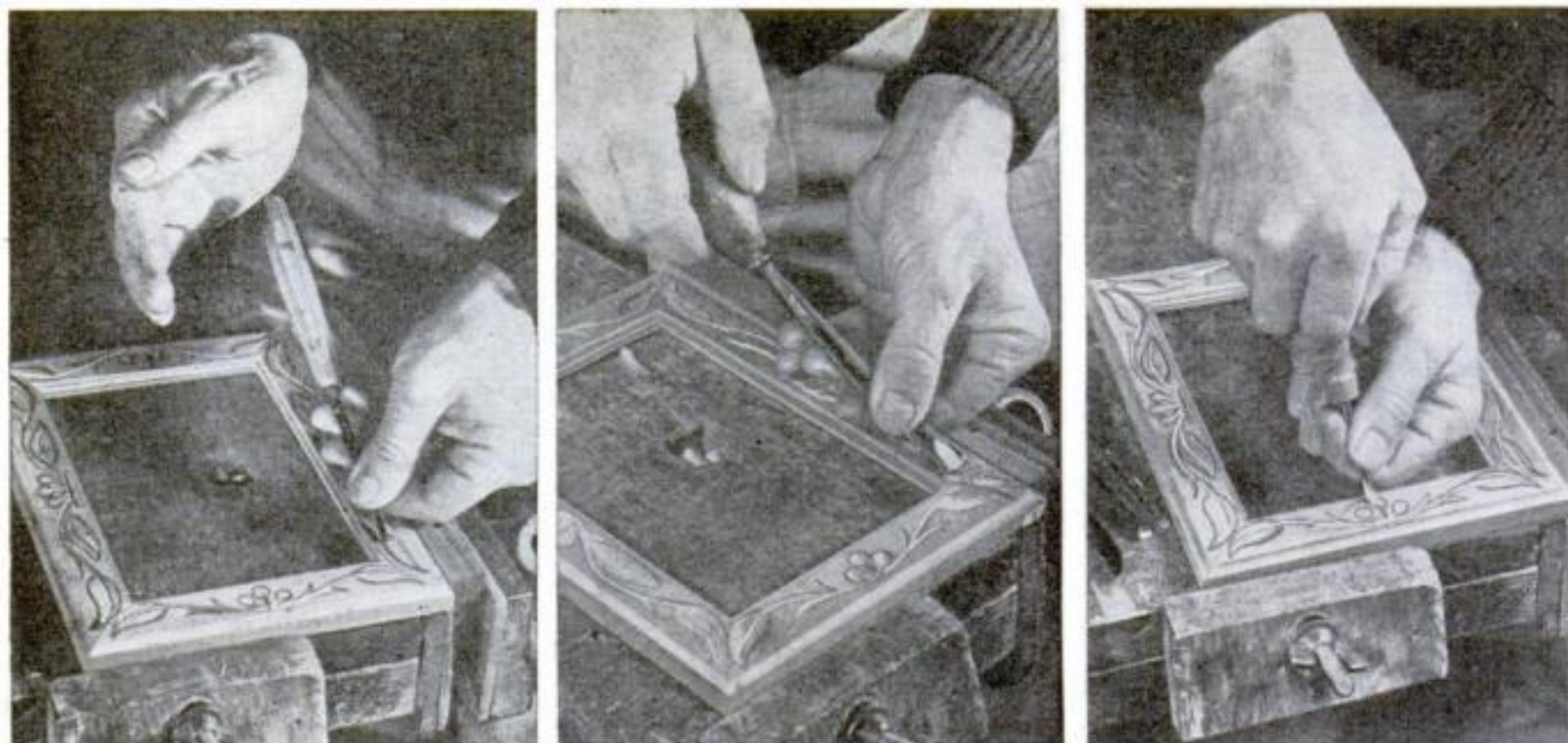
and treating it with dressing should be used after the edge of the tool has been honed.

Figure 2 illustrates an excellent stroke for heavy cutting. In this position one point of the blade and most of the edge are in action. One pass removes a large chip, and two or three complete a side. The bottom of the pocket may need trimming with the point

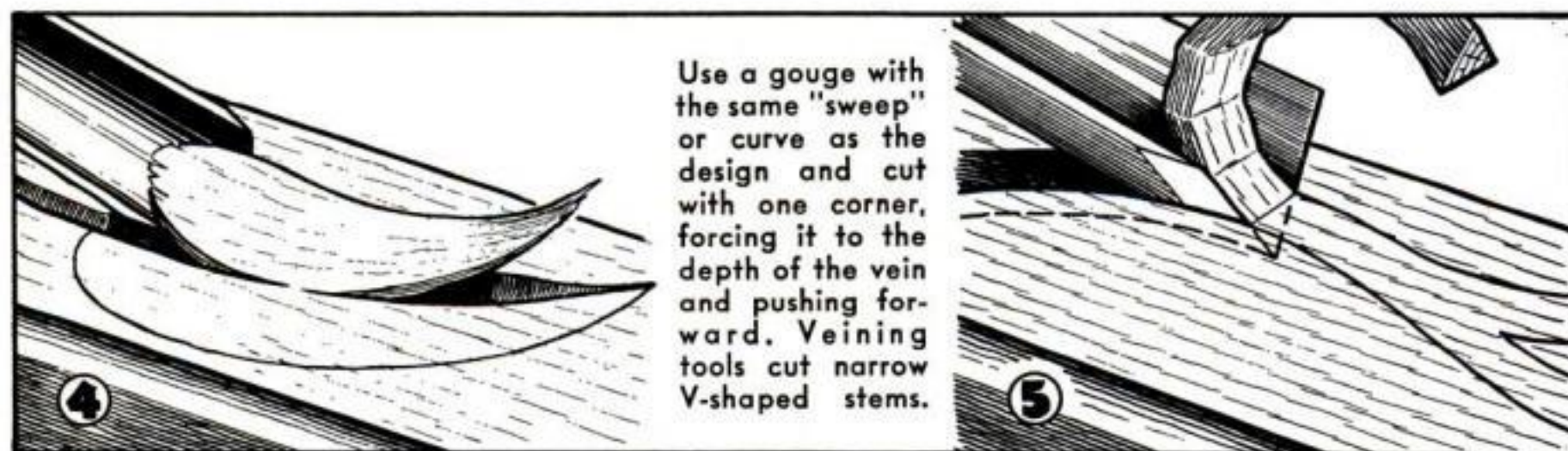
of the knife after the chips are cut free.

What tools cut curved sides? Convex curves are cut with the skew knife, but a gouge is better for concave surfaces. Hollowed-out sides can be trimmed smooth by pivoting the skew knife on its point, as in Fig. 3.

Does a false cut spoil the work? Most



Incised carving is done with a veining tool and a gouge. At left, the former cuts the center rib of a leaf, and next, the leaf is carved out with the gouge cutting at the side of the vein. By a deft rotary motion of a small gouge and a slight lowering of the handle, half a round berry is carved at the right.



slips cut a small chip from an edge. Usually the chip can be found and glued back in with quick-drying cement. Place a drop in the cut and lay the chip on it, allow the adhesive to dry slightly, and then press the chip in place. After a few minutes the repaired part can be trimmed smooth and cannot be detected.

A gash in the side can often be removed by cutting the pocket a little deeper. If a curved side rising to a flat band, as in the center circle of the box top illustrated, is cut past the line, the whole circle can be recut with a sharp ridge substituted for the band. Lost chips can be replaced by chiseling out an opening to receive a piece chosen to match the grain.

What tools are used for incised carving? Generally a veining tool and one or more gouges will be sufficient. These were the only tools required for the carving of the picture frame shown on page 146.

How is this carving done? Transfer the design, or better, sketch it, as slight variations in layout harmonize with the tool marks of the carving. Outline the stems

and shoots with the veining chisel, as in Fig. 5, forcing it forward with light blows of the right hand while guiding the point and regulating its depth with the left hand.

Hollow the leaves with a gouge, as in Fig. 4. Choose a gouge preferably with the same "sweep" or curve as the hollow to be made. Cut with one corner of the gouge, forcing it to the depth of the vein and pushing forward nearly to the center of the leaf or where the upturn of the chip begins. Then turn the work end for end and cut the rest of the chip. Rotate the gouge whenever possible to obtain a more shearing cut.

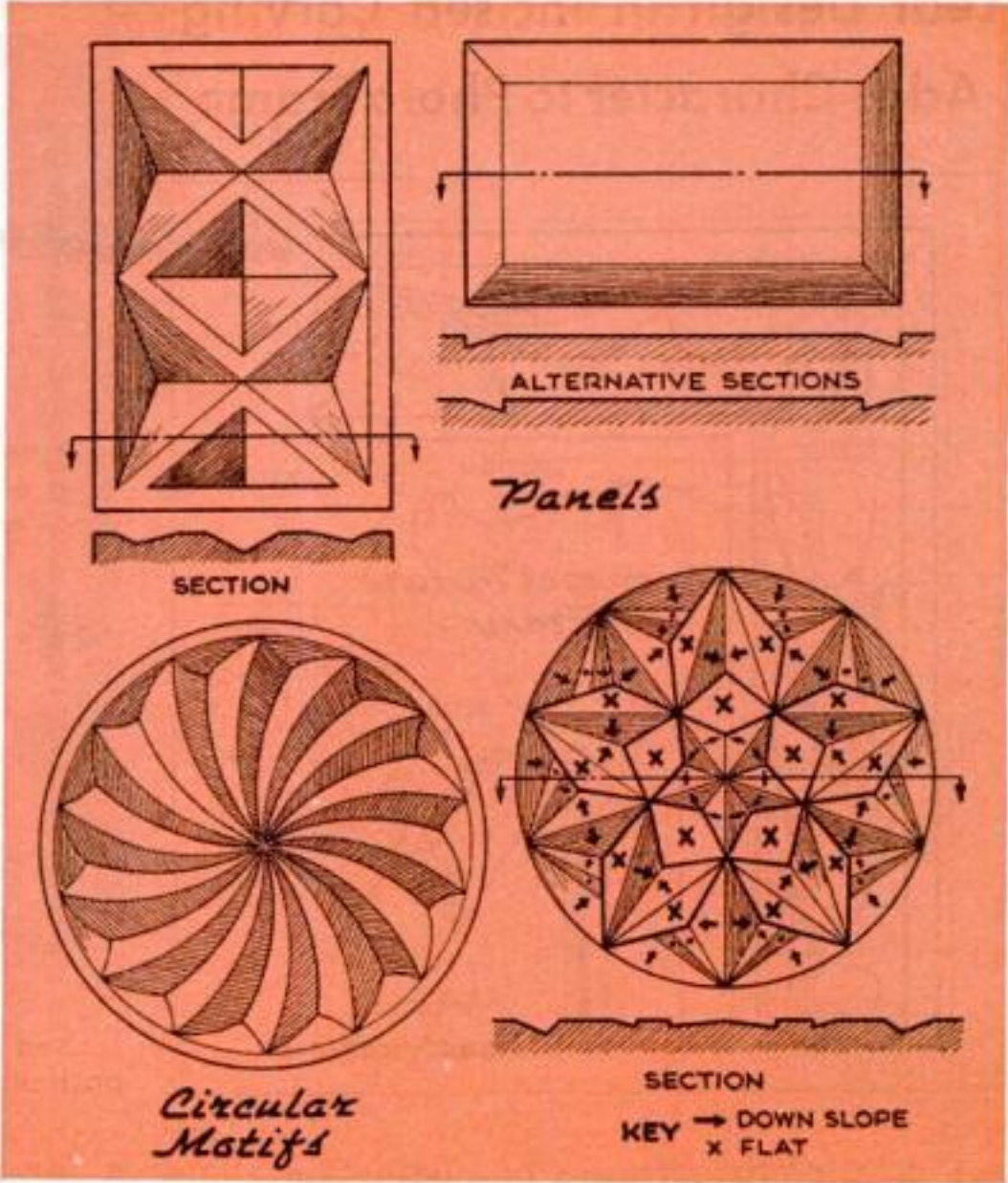
Recut the veins and deepen the leaves as necessary. Scratches and roughness caused by lifting a chip against the grain should be avoided, but make no attempt to obliterate texture resulting from sure gouge cuts.

One of the photos shows a quick method of carving small circular designs such as the berries. Choose a gouge of a sweep to match the curve, and rotate it through a semicircle, pushing the edge forward and lowering the handle. A similar cut from the opposite side lifts out a half ball, leaving a

Designs suitable for any project are possible with combinations of the same basic cuts. Some are shown at right.

cavity requiring little trimming. When the design has been completely carved, touch up the veining and the junctions of the stems, and then remove pencil marks with a square-edged cabinet scraper. To sand the picture frame, stretch sandpaper over a hard block so that softening of the crisp edges of the carving will be avoided.

What finish is best for carved pieces? Application of boiled linseed oil or shellac and wax finishes are often advised for carvings, but these afford little protection for the wood. Good high quality, nonwax flat varnishes are on the market, and two coats over a priming of thin shellac give a protective surface having a subdued glow in keeping with the nature of the decoration. If open-grained woods are filled, rub off the filler while it is still fairly soft and pick out the corners with a pointed stick.



Black Walnut Trinket Box Is Decorated with Chip Carving

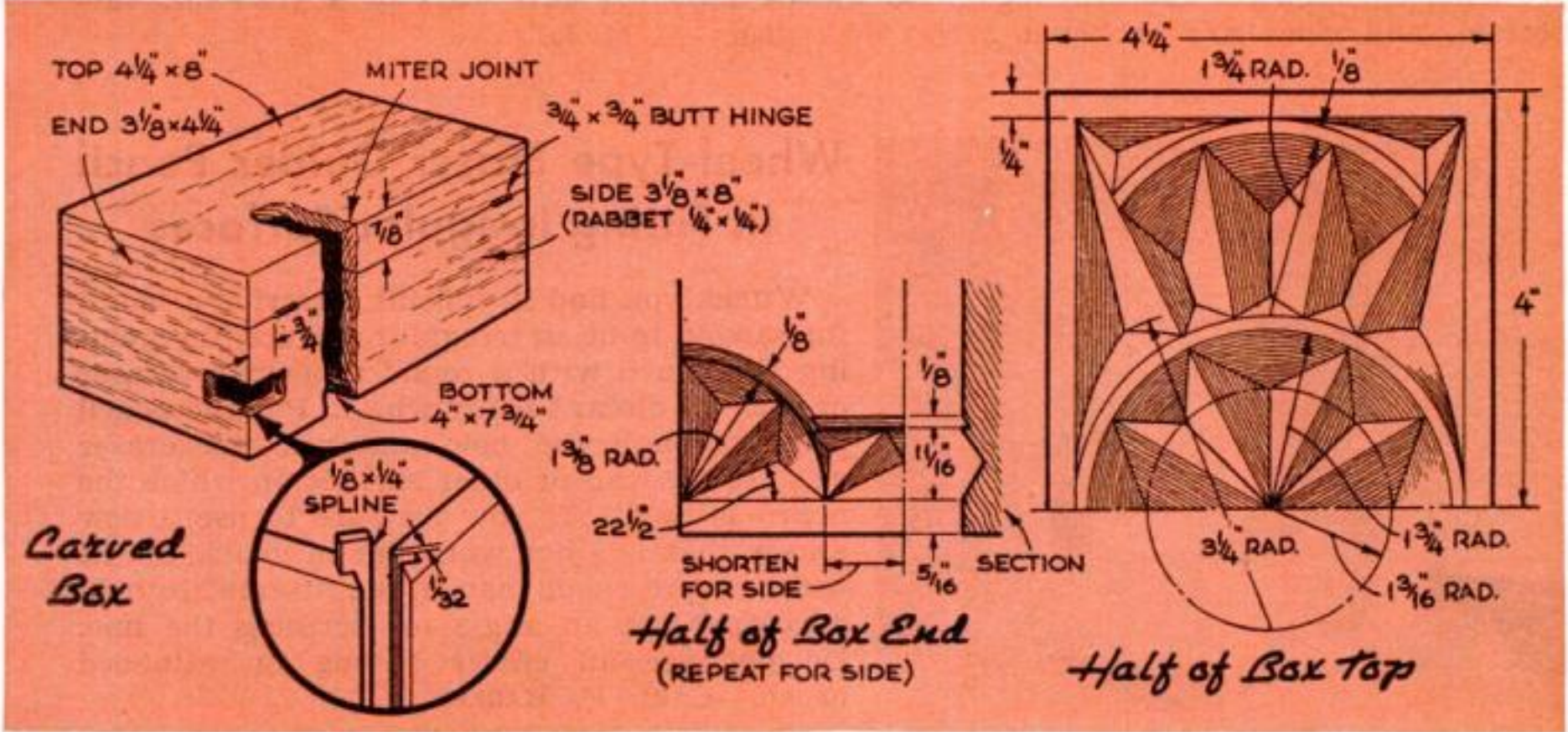
HERE is the trinket box on which the chip carving was described in the foregoing article. Plain black walnut stock $\frac{3}{8}$ " thick is excellent for the project. Cut the pieces to size and then carve as directed except for the corners, which should not be done until after final assembly.

After carving, miter and rabbet the members and groove the corner miters to take the splines. Hold the depth of the grooves

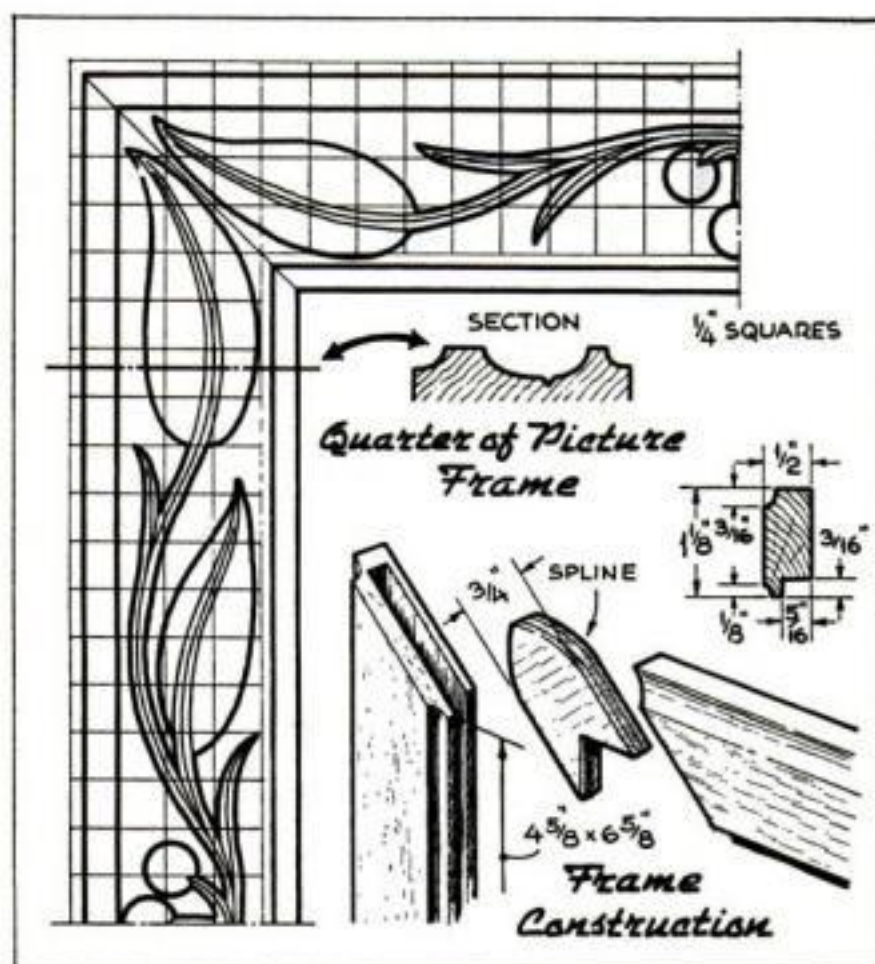
to $\frac{1}{8}$ " to keep them from showing through the lower sections of the carving.

Assemble the sides, ends, and bottom to check the joints. Then apply waterproof plastic glue and clamp lightly. Shave the edges of the toppiece with a block plane until it fits, glue it in place, and when the glue has dried saw off and hinge the lid.

Finish with flat varnish and line with suede or polished leather.—E. M. L.



Leaf Design in Incised Carving Adds Character to Photo Frame



FOR a picture frame of distinction that will do justice to your favorite photograph, you will need no more than a 32" strip of $\frac{1}{2}$ " by $1\frac{1}{8}$ " unfigured red gum or other close-grained wood, a veining tool, and one or two gouges. The classic leaf design shown above is intended for a frame to accommodate a 5" by 7" photo, but it can be lengthened without destroying its effectiveness if the photo is larger.

Mold the edges before making the frame, if desired, or gouge the coves after final assembly to harmonize with the leaf carving on the flat face. Make all the parts and assemble them before adding the carved decorations. As shown in the drawing, the top, bottom, and sides are rabbeted $\frac{3}{16}$ " by

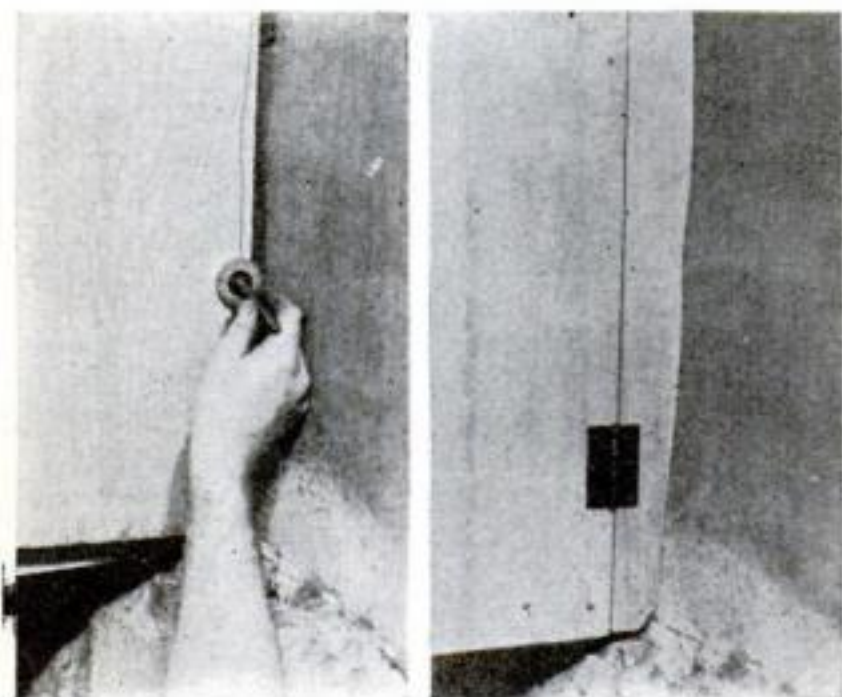


Incised carving with harmonious classic lines is particularly suited to ornamenting small projects.

$\frac{5}{16}$ " on the inside of the back to take the photograph. Cut the mitered corners accurately to assure tight joints, and join them with blind splines, as shown. Three-layer plywood is excellent material for such splines, giving strength in two directions. Work the mortises by hand or with a shaper, and make a trial assembly before gluing up the parts and clamping.

When the glue has dried thoroughly, surface the frame with a scraper, and then carve, following the directions on pages 142 to 145.

Stain may be applied after the final light sanding, or a natural color may be obtained by applying two coats of a good flat varnish.—E. M. L.



Wheel-Type Eraser Guides Pencil in Fitting Irregular Surfaces

WHERE you find it difficult to scribe a board for sawing to fit an irregular surface, try guiding the pencil with a round typewriter eraser or a small discarded toy wheel. Put the pencil point through the hole and roll the eraser against the wall or other surface on which the board is to fit. If you are sure to use a new eraser that has not worn flat in spots, the fit will be more exact than if you attempt to hold a compass at an angle for scribing the line. Do not use an eraser having an attached brush.—CARL F. BAREIS.

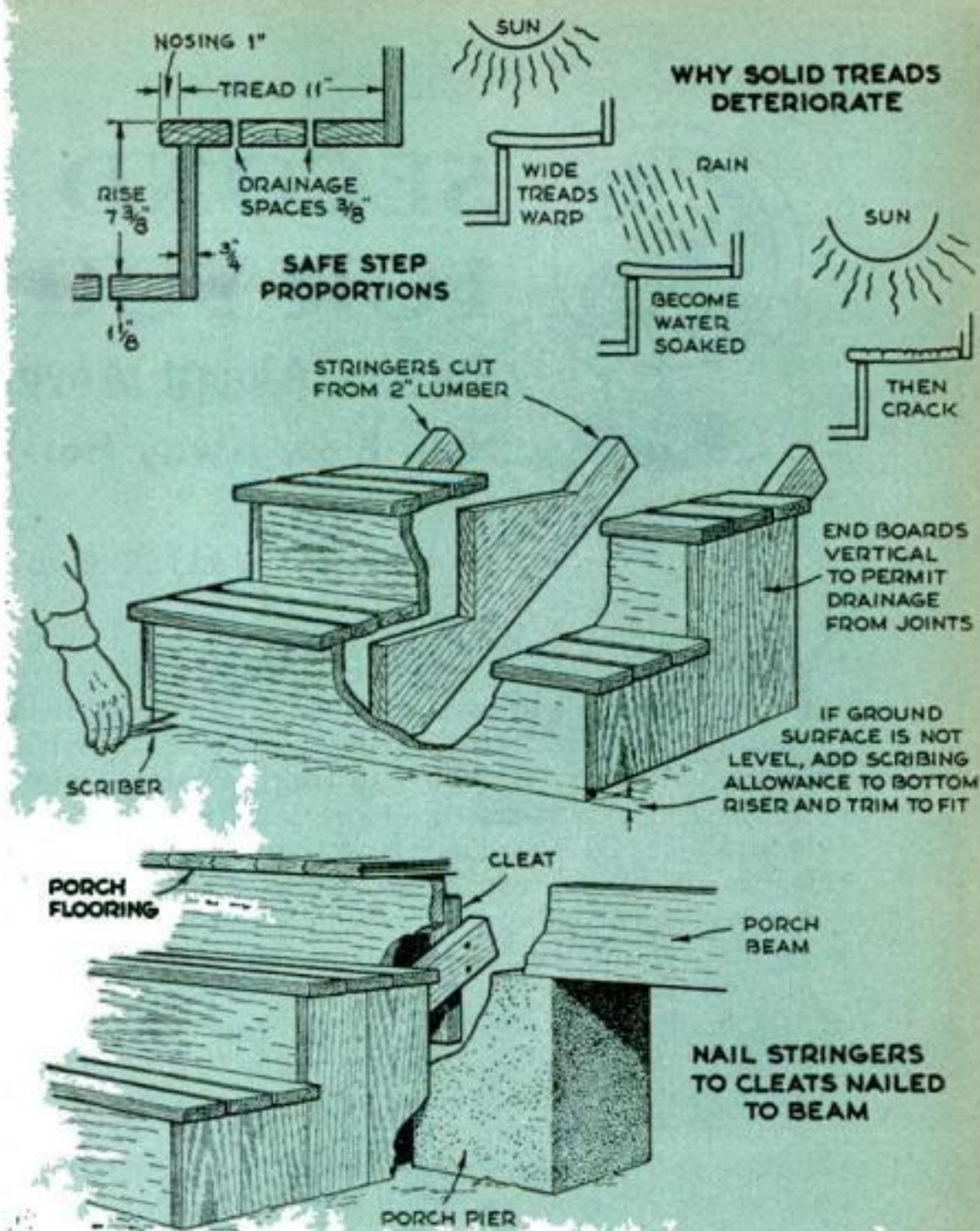


Good Design Lengthens Life of Outdoor Stairs

DRAINAGE is one important factor that will increase the life of outdoor wooden stairs. Building them so as to lessen the wear from hard and steady usage is another.

Treads made of slats instead of one solid board and end boards installed vertically instead of horizontally are means of improving drainage. Wide boards tend to rise at the edges under heat from the sun and allow rain water to stand on them. Such boards, expanding and contracting with alternate soaking and drying, finally crack and rot sets in. Slats permit rain to flow through between them and are less apt to warp. When end boards are placed vertically, rain water will not stand in the joints.

One possibility of damage from hard usage can be avoided by extending the nosings not more than 1" beyond the tread. Wider nosings may break under a heavy weight. Wear also can be reduced by making the tread wide enough for sure footing



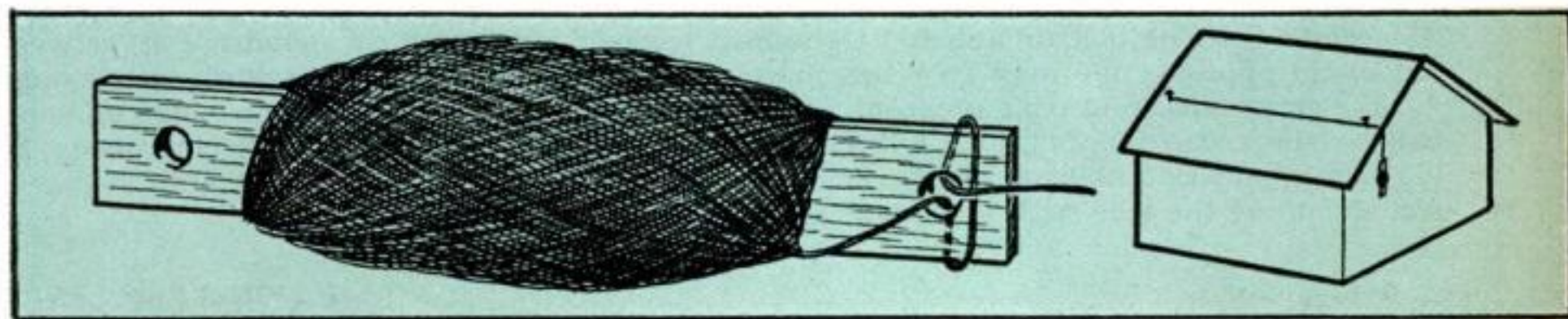
and the rise low enough for comfort and thus discouraging mistreatment. The dimensions shown are good, but tread may be as wide as 12" and the rise as low as 6".

Nail heads left exposed are another contributor toward shortening the life of stairs. The sun's heat expands nails and simultaneously contracts the wood. Consequently, the nails may be forced out far enough to loosen their grip and weaken the stair structure. To forestall this, countersink all nails, give the stairs a priming coat of outside paint, and then fill the holes with putty or calking compound, preferably the latter. Give the treads several coats of deck paint.—J. M.

Quick Hitch Made on Chalk Line Keeps It from Unwinding

LOOPING a chalk line through a hole in the end of the small board on which it is wound keeps the line from unrolling at the wrong time. The line can be looped at any point, and the loop thrust through the hole

and snagged over the end of the board as shown. Make the hole big enough for the loop to go through easily. This hitch also converts the ball and board into a plumb bob for making a vertical line.—R. A. J.





SECOND WIND FOR YOUR FAN

**Repairs Almost Anyone Can Make
Help Blow Away Hot-Weather Cares**



By **WALTER E. BURTON**

YOU may be one of those fortunate souls who thrive on hot weather, or you may spend your summers in the mountains or at the shore where ocean breezes blow. If so, you can skip what's coming. But if you are like most of us mortals and perspire profusely, and if that electric fan on which you depended in former years has been out of commission since the beginning of the war, then this is your meat—and without red points. Dig the fan out of the junk closet, and let's get to work.

Sometimes trouble that develops even after long use can be traced back to defects in manufacture, but most often a fan misbehaves or stops altogether because of ordinary wear or an accident. Falls cause most ailments.

A broken or dented case resulting from a fall may cause a burned-out winding by throwing the bearings out of alignment and increasing the load so much that a coil burns out. If you are familiar with motor repair and can get the necessary magnet wire, you can replace a winding yourself; if you aren't, it is best to see an experienced repairman.

One way to realign bearings in a sprung motor housing is to clamp the motor in a vise and carefully apply pressure in a direction roughly opposite to the direction of the force that put the bearings out of line. This is possible with die-cast and pressed-steel housings, but it may crack one of cast iron. Check the shaft, too, to see if it has been sprung.

Misalignment of motor end caps, sometimes occurring when dirt gets under a cap during reassembly, may produce tightness between the bearings and shaft. In putting any kind of motor together, always turn the shaft by hand before switching on power. If it doesn't turn freely, check the end caps. A loosening of one bolt or nut and tightening of an opposite one may free the shaft.

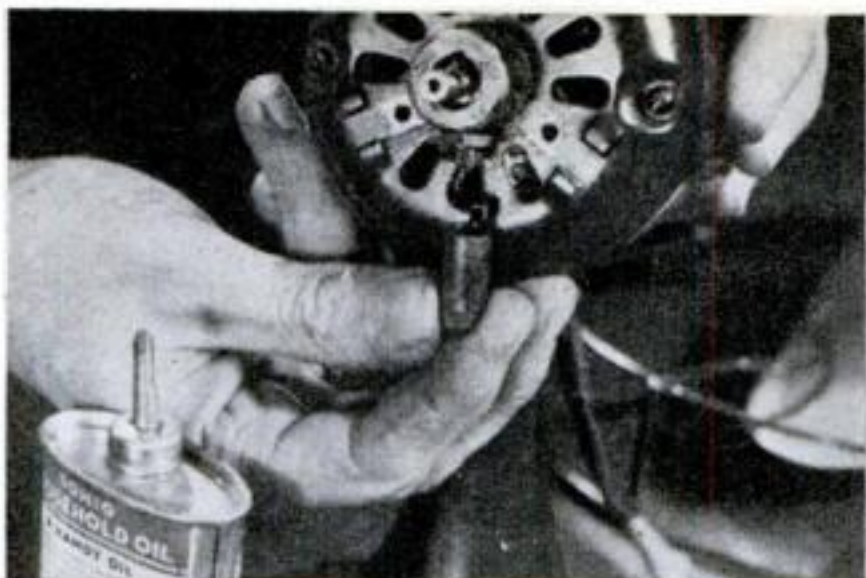
No electric-motor bearings, except sealed ball bearings, can function long without oiling. An application at least once every season should be the rule with most fans. Sat-

urate the felt oil pads, if your fan has them; or if it has oil cups, take them off, clean them and the wicks in kerosene, and refill with a good light motor oil. In putting a wick and spring back in a cup, make certain that the inner end of the wick enters the bearing hole and presses against the shaft, for if it doesn't touch, the oil may never get to the bearing. A motor having an oil reservoir and a wick or pad to carry the oil to the shaft needs only fresh oil, but if a wick becomes gummed, it must be removed and cleaned.

When you take an oscillating motor apart for any reason, it is a good idea to wash out the old grease in the worm-gear assembly at the rear end of the shaft. Replace it with petroleum jelly or other suitable lubricant.

In brush-type motors, flexible-wire pig-tails are sometimes used on the carbon brushes to provide good electrical contact between them and the tubes in which they are encased. Broken pigtails can be refastened or replaced with a new brush-and-tail assembly. Any brush that has worn extremely short or has considerable play in its tube should be replaced. See that all brushes are in their original position and that their worn ends fit the contour of the commutator. If new brushes are installed, it's well to seat them with a brush-seating stone or by sliding a strip of sandpaper (not emery) back and forth around the commutator while the brush bears against it. Grit from sandpaper won't become embedded in the commutator metal, and it is a nonconductor. A sanding drum of the proper diameter can, of course, also be used.

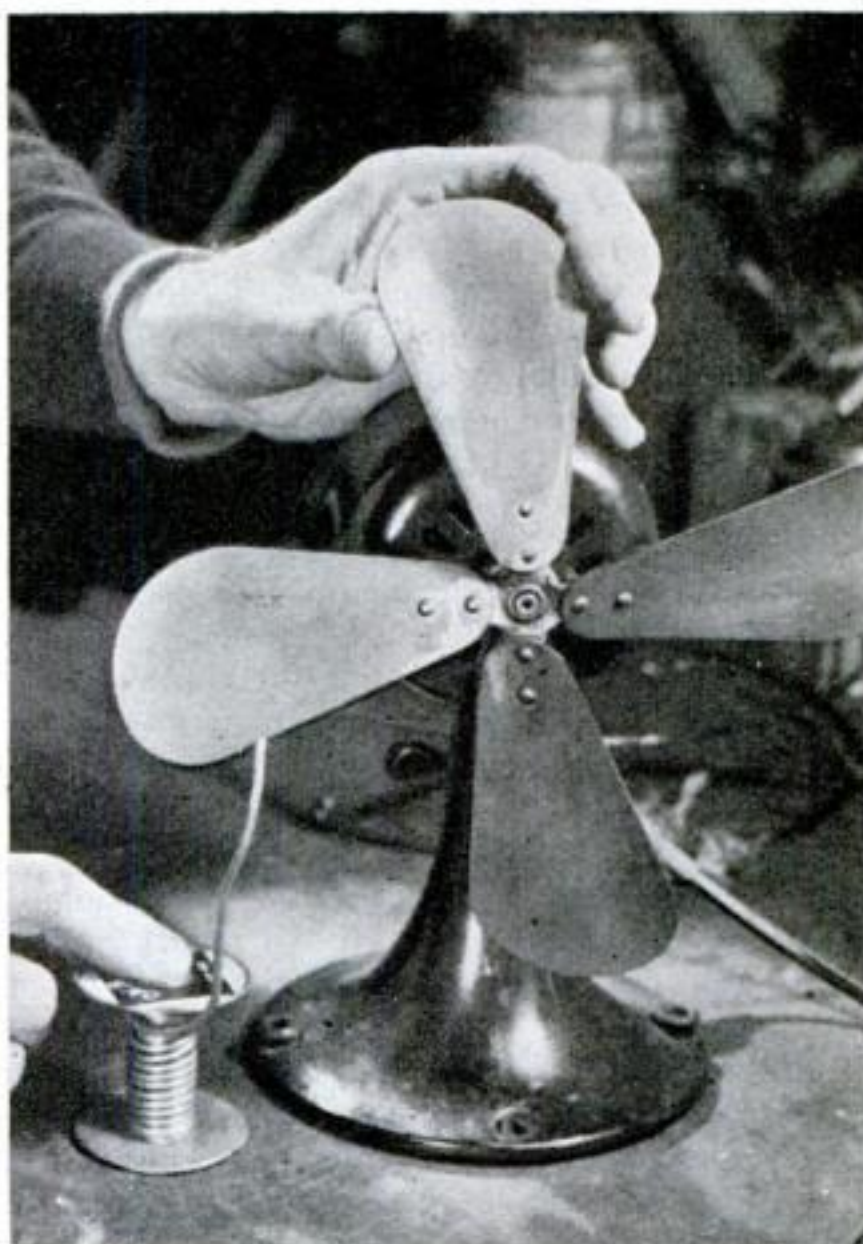
Wash a dirty or greasy commutator with sparingly applied dry-cleaning fluid or kerosene. Dirt between segments may be removed by gently scraping with the edge of a small screwdriver blade. True a badly worn commutator by mounting it between centers in the lathe and taking just enough cuts to do the job. Brush housings on some motors can be adjusted for clearance. Be sure they do not touch the commutator segments.



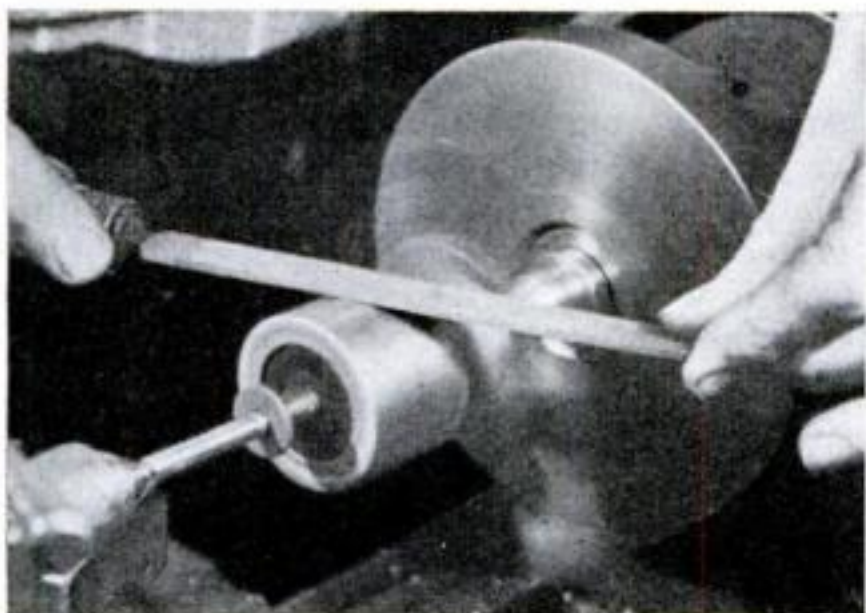
Cleaning and refilling oil cups at least once each season will add life to your fan. Take care that reinstalled wicks actually reach the shaft.



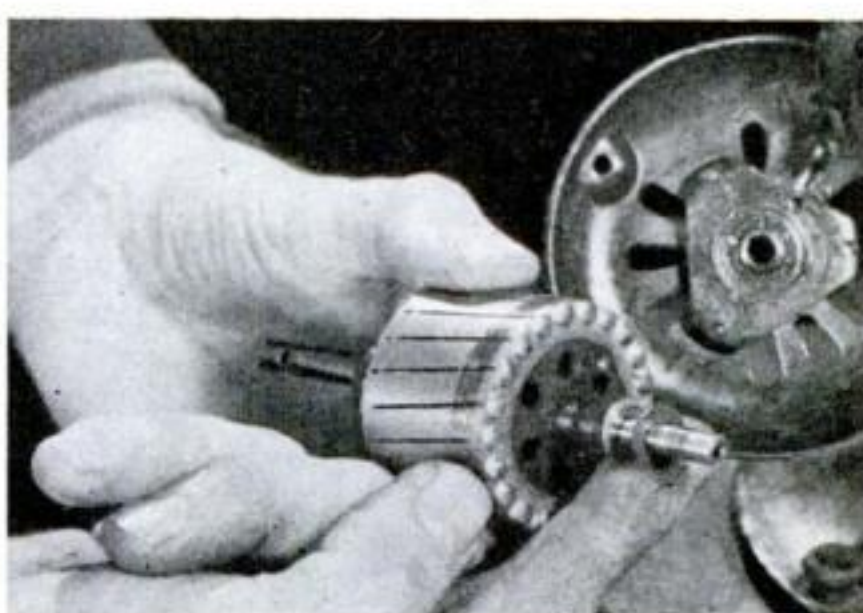
Heat and oil from a bearing may soften insulation on a cord at the base. Check inside the housing, too, and install a new cord or use friction tape.



With a length of wire solder used as a pointer, these fan blades are rotated by hand in a test to be sure that the tips revolve in the same plane.



This rotor rubbed against the stator poles, though the bearings, usual source of such trouble, weren't worn. It was corrected by light filing in a lathe.



When removing an armature, note the position and distribution of the fiber or metal washers on the shaft and replace them in exactly the same order.

On one old motor that buzzed instead of running, it was found that the stator poles were binding the armature. The bearings did not appear worn, so the armature—a squirrel-cage type having a cagework of copper bars running through a laminated steel body—was filed down a few thousandths of an inch in the lathe. It then ran perfectly with no noticeable loss of power.

Examine the connection plug and cord of a fan that is electrically dead, and if the insulation is badly cracked or there is other

damage, install new ones. Insulation near the motor is sometimes softened by oil that creeps down from a bearing. In such a case, check also on the cord inside the housing.

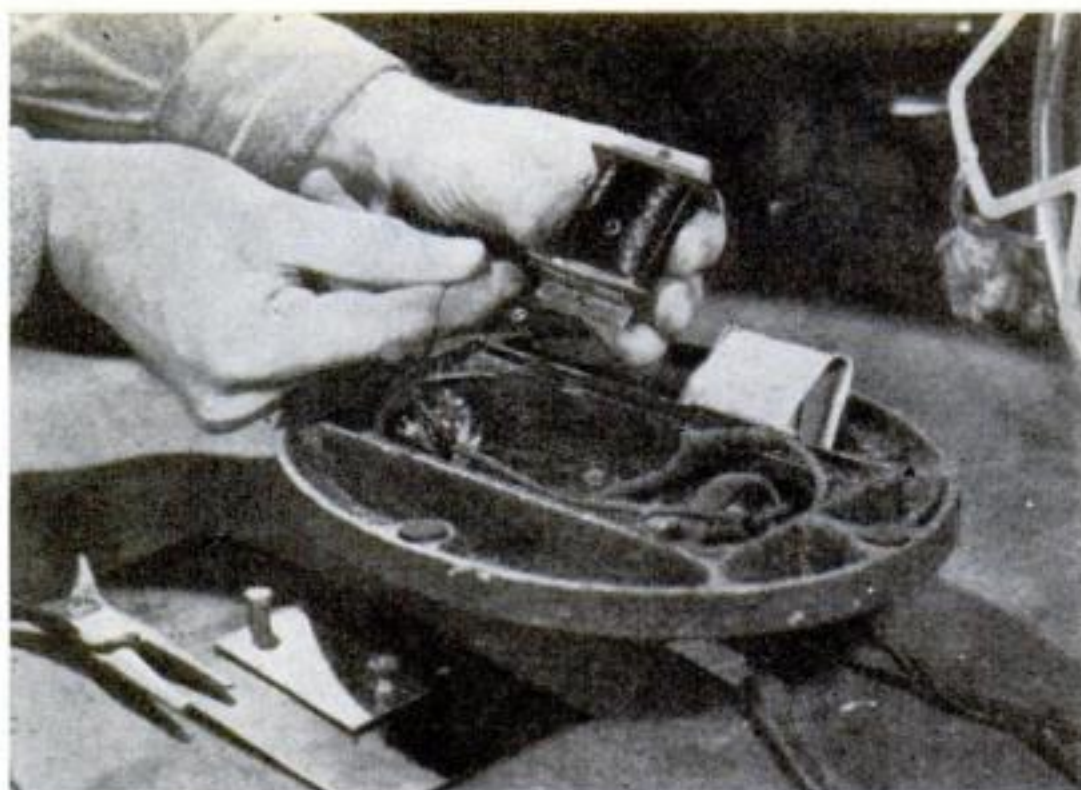
The switch in the base may be checked for open circuit by shorting it with a piece of wire. Controls on multispeed fans usually employ resistance or choke coils, as in Fig. 3, or they may have a series transformer or a tapped auxiliary winding in the motor. A resistance-wire break can be brazed or hard-soldered if you can reach it. Usually it will

be found at a terminal connection. A choke-coil covering can be removed and the wire unwound to reach a break, which then may be soft-soldered. Wrap the joint in brown paper or other insulating material before rewinding.

A loose or damaged fan-blade guard is a real hazard. Straighten any bent members, peen loose rivets or replace them, and tighten all bolts that hold the guard. If the threads in a hole are worn, drill the hole for a larger bolt and rethread with the same number of threads the old hole had. Replace a 6-32 bolt, for example, with an 8-32. Put a lock washer or a self-locking nut on each bolt.

Broken guard joints can be re-welded, brazed, or hard-soldered. Or a break may be bound with fine brass or copper wire and jacketed with soft solder. Use an acid flux and then wash the joint with hot water.

In removing a blade assembly from a motor shaft, take the setscrew out completely, for it is often difficult to tell whether a hub is binding or the setscrew is caught in a depression. Most bends and dents in blades can be removed with a machinist's hammer supplemented by one with plastic ends.



Replacing a broken terminal connection on a choke coil. The coil reduces motor speed when the switch is set at "slow."

Cracks in fan blades are dangerous. Drill a small hole directly in front of a crack, as in Fig. 1, to stop it from spreading, and then hard-solder or rivet a strip of metal across the crack, as in Fig. 2. The patch will throw the fan out of balance, and it should be counterbalanced at the opposite side, the weights being distributed if there is an odd number of blades.

Test with a pointer of some kind to see that the tips of the blades rotate in approximately the same plane. Adjustments may be made by bending near the hub. The pitch of the blades should also be the same.

Some fans have unguarded rubber blades; some have blades of looped tape or ribbon; or you may acquire a fan motor that has no blades at all and no guard. Figure 4 illustrates a method of making leather blades and a wooden hub to fit the motor shaft.

Plywood blades on a maple hub block serve on the shop-ventilating fan at left. The motor was part of a 16" oscillating fan. Blade replacement and patching and a wiring diagram are shown below.

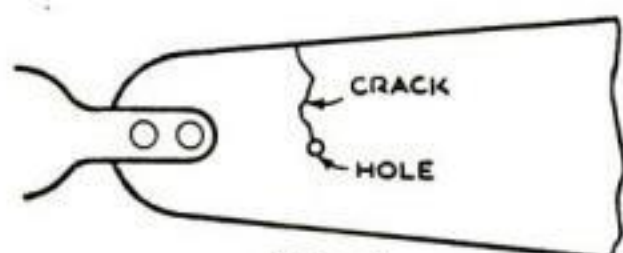
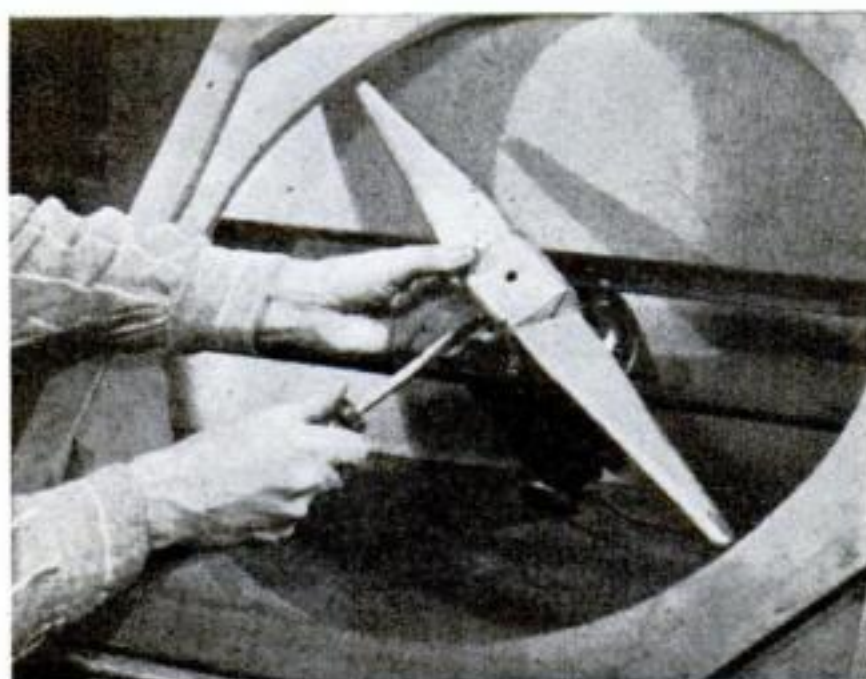


Fig. 1

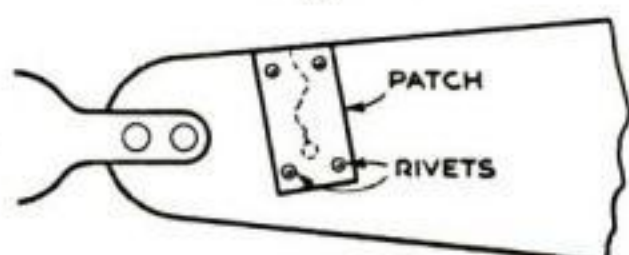


Fig. 2

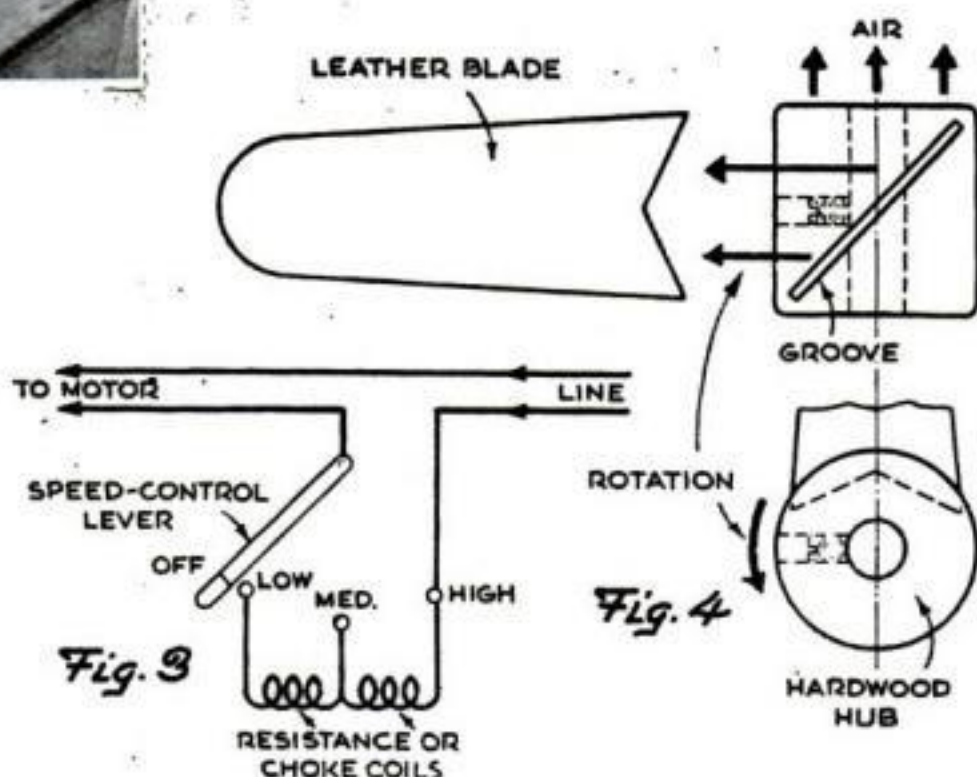


Fig. 4

leather, and cement them in grooves in the hub at a 35 or 40-deg. angle. A few short brads will hold the blades in place while the adhesive sets. Such lightweight blades should be a little longer than metal, say a 7½" leather blade replacing a 5" metal one. If too great a load is put on the motor, trim down the blades until the motor does not overheat.

Induction-type fan motors are usually designed for a specific number of blades. For good synchronization, four blades are used with a motor having four stator poles and operating at 1,800 r.p.m., six blades with one having six poles and operating at 1,200 r.p.m. A six-blade fan can burn out an 1,800-r.p.m. motor with four stator poles.

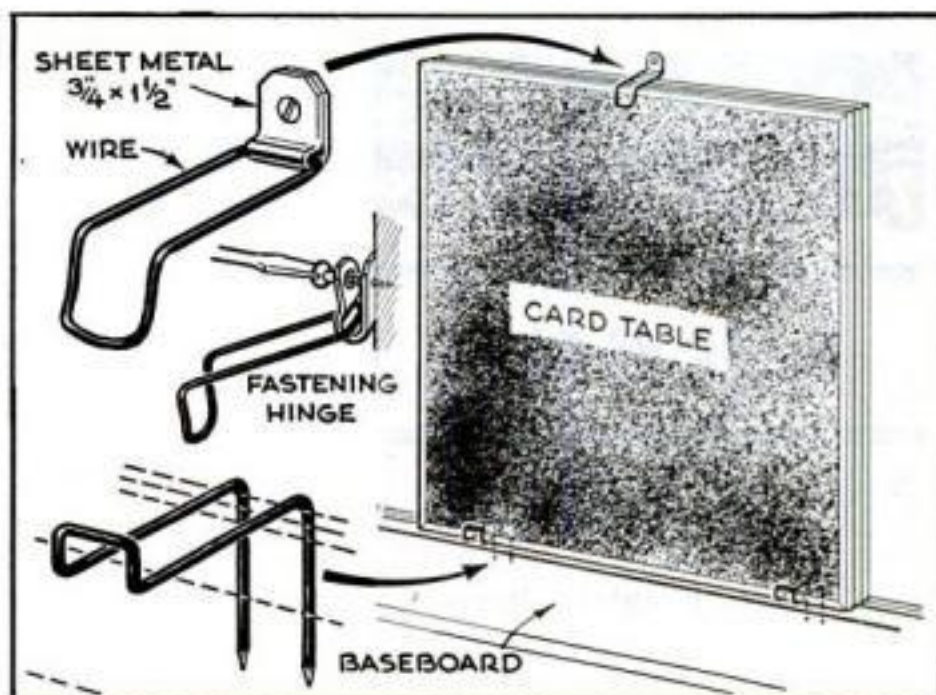
This may not occur on so-called silent fans having slow speeds and large-area blades, but it is a good idea to be certain you do not overload any fan when you install new

blades. Trial and error may be necessary to find out how much load a fan will carry. If the motor gets so hot you can't hold your hand on it, shave down the width of the blades or decrease their pitch.

Blades made from ¼" plywood serve well on belt or motor-driven slow-speed fans used for ventilating shops and attics and for forced circulation in hot-air furnaces. Two blades, arranged like a plane propeller and tapered toward the ends, are usually sufficient. Mortise and glue them in a wood-block hub, and hold the hub to the shaft with setscrews.

When an overhauling job has been completed, appropriate enamel is a good finish on the base, motor housing, and guard. A fan used on the floor should be a light color that can be easily noticed. Thin brushing lacquer, colored or clear, will renew a crackled or wrinkled-enamel finish.

RACKING A CARD TABLE out of the way is possible with three supports made, as shown at right, from coat-hanger wire. Held just above the baseboard, the folded table will not interfere with sweeping or with other articles in a game closet or a coat closet. Make all pieces a fit for the table and have the spiked ends of the lower supports about 4" long. One screw holds the upper hinge piece. It is best to drive it into a fiber screw anchor if the wall is of plaster.—E. H. SCHMIDT.



YOUR FAVORITE OILSTONE need not be thrown away if it has worn beyond further practical use. It can be resurfaced by grinding for a few minutes on a cast-iron lap or a sheet of plate glass. As an abrasive use a piece of discarded soft grinder stone or window-ledge sandstone broken up, hammered to a powder, and mixed with oil. Grind with a circular motion and apply plenty of elbow grease to the task.—IVAN GROSVENOR.



MORTISE AND TENON



"But you said he was a bird dog."



GREEN GROWS YOUR LAWN

By MORRIS A. HALL

HAS your lawn been satisfactory this summer, wholly satisfactory? Have color and texture been even throughout? Has growth been as vigorous as you would like? If the answer to any or all of these questions is "No," now is the best time to repair damage.

Now is the best time, too, to start a new lawn. Experts are agreed that fall is the most satisfactory season for seeding, for planting new lawns and refurbishing old ones. The enemies of seedling grass are extreme heat, drought, and weeds, none of which is prevalent in winter.

When spring planting is practiced, seedlings appear at the beginning of the hottest and driest weeks. Weeds are then entering their period of greatest activity, and crab grass, which by July is literally elbowing aside all desirable growth, is establishing its roots, as shown on the facing page.

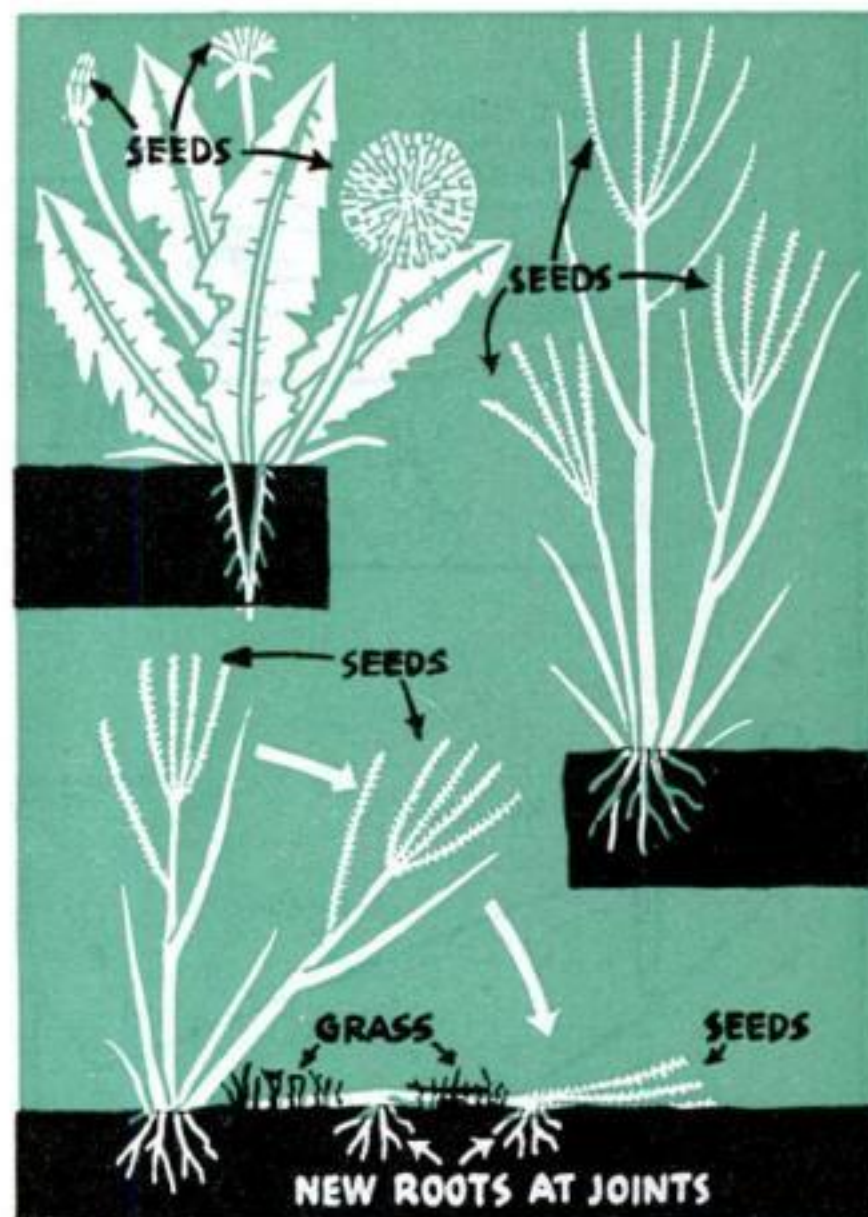
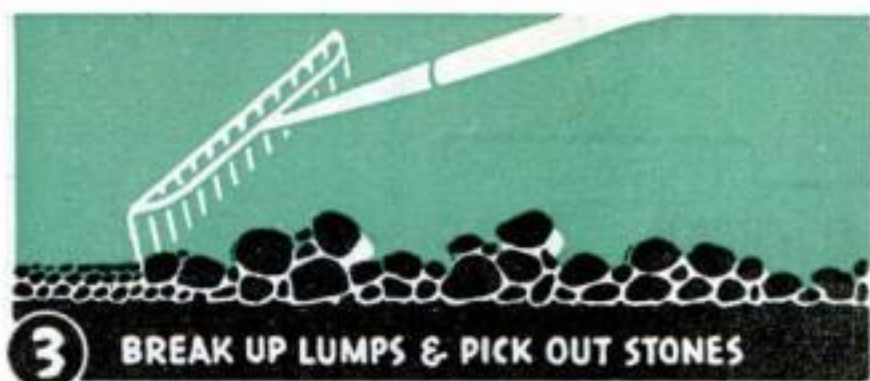
Grass is really a cool-weather plant. Young shoots from seed put in the warm, mellow ground after the middle of August or in September will be sturdy and vigorous by the time cold weather strikes. In the latitude of New York, the first evening dews

begin to fall around August 15, and conditions continue to be favorable well into October when the young grass will have gained sufficient root and above-ground growth to withstand almost any kind of weather.

Patching is much like planting a new lawn, except that you need to do it only in spots. Consider why the lawn failed in places. Was it because of poor soil, lack of sufficient seed or plant food, too much shade, or digging by children or dogs? Make the corrections you feel are necessary, and then scratch the surface and put in plenty of good seed carefully distributed. Firm this down so the seed won't blow or wash away, and water it lightly to start growth.

Where bare spots are large, it is best to dig and turn the soil to aerate it, and you should add fertilizer. If traces of copper poisoning from the runoff of leaders are present, dig out the old soil, discard it, and put in new topsoil mixed with humus and fertilizer. Do this also if the soil is green from excess acidity, or if kerosene has been spilled on it, as for killing ants, or if oil, crankcase drainings, gasoline, or salt has dropped on it, for it will have been ruined for grass.

If your lawn has a chain of bare spots



IF IT'S SEEDED THIS FALL

connected by others where the grass is thin, it is best to turn over the thin areas as well as the bare. Reworking one fairly large spot is easier than doing a lot of small ones, and the thin grass probably needs replenishing anyway. In digging, however, leave the old grass roots in the soil.

The nine steps in starting a new lawn are illustrated above. If there are oaks and other hardwood trees on the land, the soil will probably be acid. Test for this, if you wish, with litmus paper from a drug store. A change in color of the paper will indicate whether the soil is acid. Lime will correct this condition and sweeten the soil. Don't use too much. It is better to use too little than too much and to repeat the treatment after a month or so if the soil is still acid.

If the ground is too shaded, remove some of the lower limbs of the trees to let in more sunlight and air. Clay soil will need a little coal ash, sand, or peat and a great deal of light soil mixed in for a depth of 5" or 6". And level the plot as much as possible, for steep slopes wash badly.

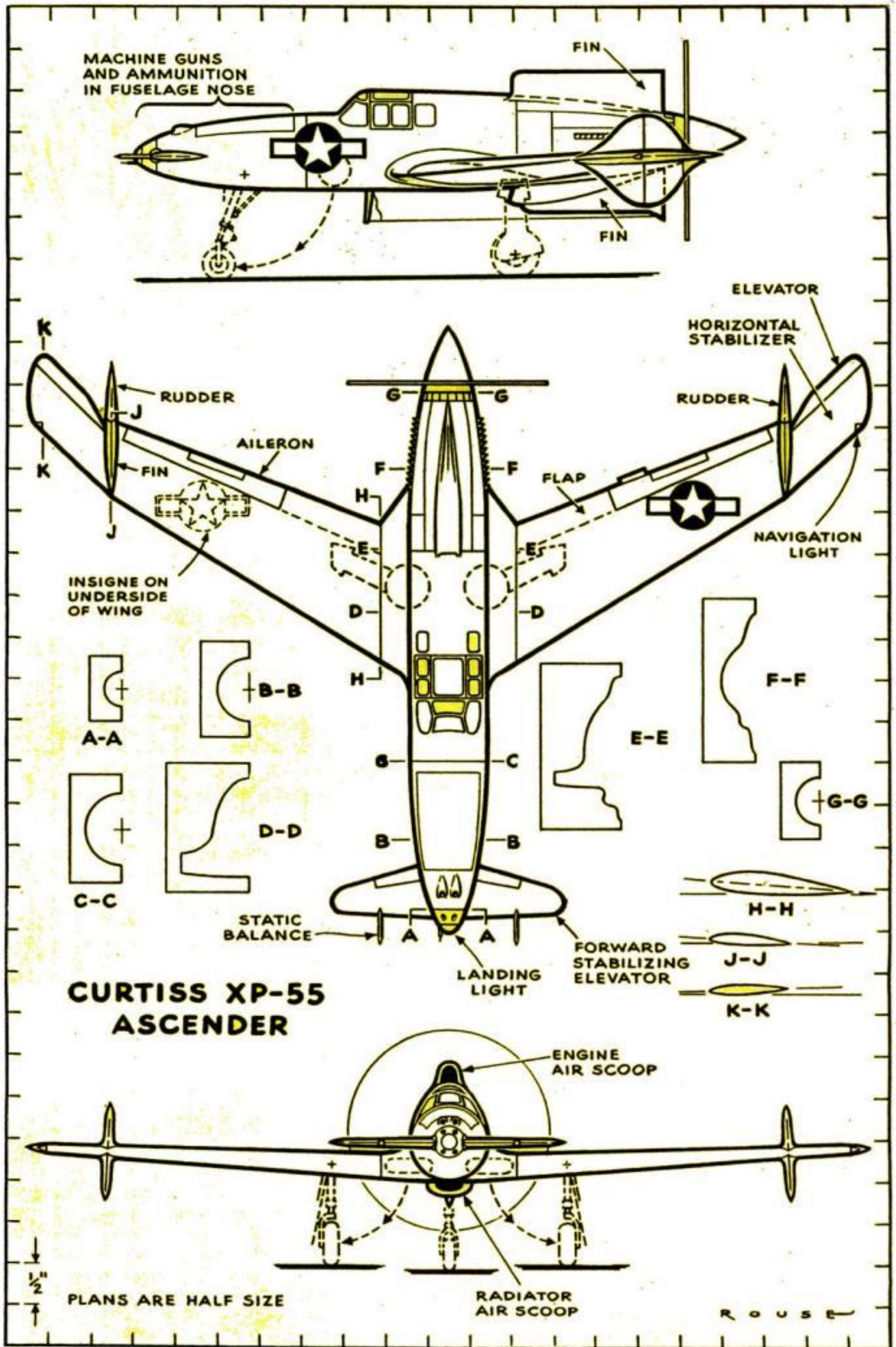
Plant food is still more important. Humus, which is rotting vegetation, is good, and so are animal manures and commercial fertilizers. Remember that grass, being green

and essentially all foliage, will need nitrogen. Phosphorus is also required, but potash, which feeds fruit, is not needed at all.

Commercial fertilizers are designated by a string of three figures, the first being the percentage of nitrogen, the second phosphorus, and the third potash. Or a good lawn fertilizer can be made up from 1 part nitrate of soda and 3 parts cottonseed meal. Both supply nitrogen, the soda up to 16 percent and the meal up to 7.5 percent plus nearly 2 percent of phosphorus.

Always buy good seed—you use less of it in time. Broadcast it plentifully and in two directions to spread it evenly. Good seed houses can be trusted with the mix. They usually give you Kentucky blue grass, fescues, bents, and a little rye. If you like clover, seed it separately and sparingly; it spreads rapidly. Clover helps a lawn by drawing nitrogen into the soil from the air.

Rolling and mowing are the final important steps. Roll lightly after the seed has been put in. Begin mowing when the grass is 2" or 3" high, and never cut too short. Keep up your rolling as you do your mowing. England's perfect lawns were achieved, as one British gardener put it, by planting once and rolling for a couple of centuries.





You can't tell whether it's coming or going, but the Ascender shows that tail-first flying has arrived.

FLYING BACKWARD INTO THE FUTURE

Modeling the Ascender XP-55 Offers Penknife Pilots a Close-up of One of Our Most Remarkable Tail-First, Pusher-Type Planes

WARPLANES, like soldiers, rarely become famous by doing their fighting on the proving grounds. Out of hundreds of experimental planes designed and built in the course of the war, only a few have attracted any public notice.

If the Curtiss XP-55 Ascender has proved an exception, it is not for what it has accomplished in battle, but rather for the promise it holds as a prototype of planes to come. Tail-first or canard-type craft have the advantage of locating tail surfaces in relatively undisturbed air. This permits more positive reactions to movements of the surfaces so that more control can be obtained with smaller surfaces. Greater maneuverability also results from the canard's center of gravity being closer to the center of the plane. The Ascender has a 41' wing span and a length of 30'; a 1,270 hp. engine drives a three-bladed propeller which can be jettisoned quickly in the event that the pilot has to bail out.

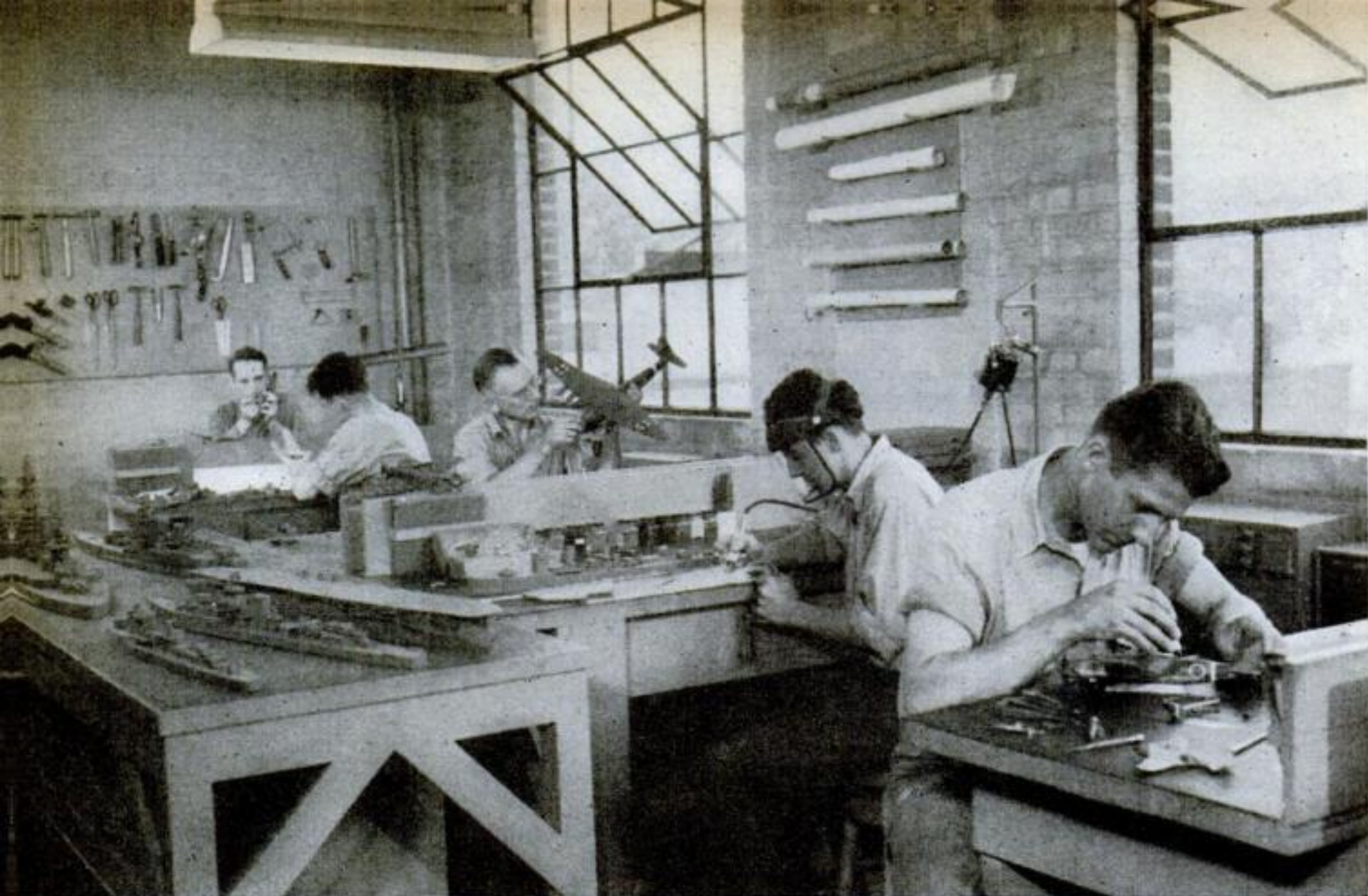
Plane modelers who have been following this series will need no special instructions for selecting materials. Whether you choose balsa or other wood, carve the fuselage out of one block and recess the underside slight-

ly to receive the wings. The large number of perpendicular surfaces employed in the Ascender will test your craftsmanship: you can either carve them out of the main blocks or fashion them separately and glue them in place. Some of the small surface details can be made of plastic composition wood.

Glue the parts together, sand the model thoroughly, and apply several coats of airplane dope. Paint the glass-enclosed portions white with a black-line trim. A celluloid disk is mounted under the spinner.

Facing the camera, the Ascender's forward stabilizing elevators give the impression of foreshortened wings. Operated in conjunction with other control surfaces, they increase the plane's air-response.





Craftsmen in the service turn their civilian hobbies into important help for air fighters in the Pacific.

NAVY MODELMAKERS BUILD

WHEN the need for models of enemy planes was first felt by the Navy, its Bureau of Aeronautics Special Devices Division turned to men who had made a profession or a hobby of modelmaking in civilian life. The result was that the Navy was soon turning out model after model of enemy planes that reached perfection in every detail—planes that could be photographed against projected cloud backgrounds, thus allowing our pilots in the Pacific to identify immediately Jap planes that they had never seen before. And this was done often with

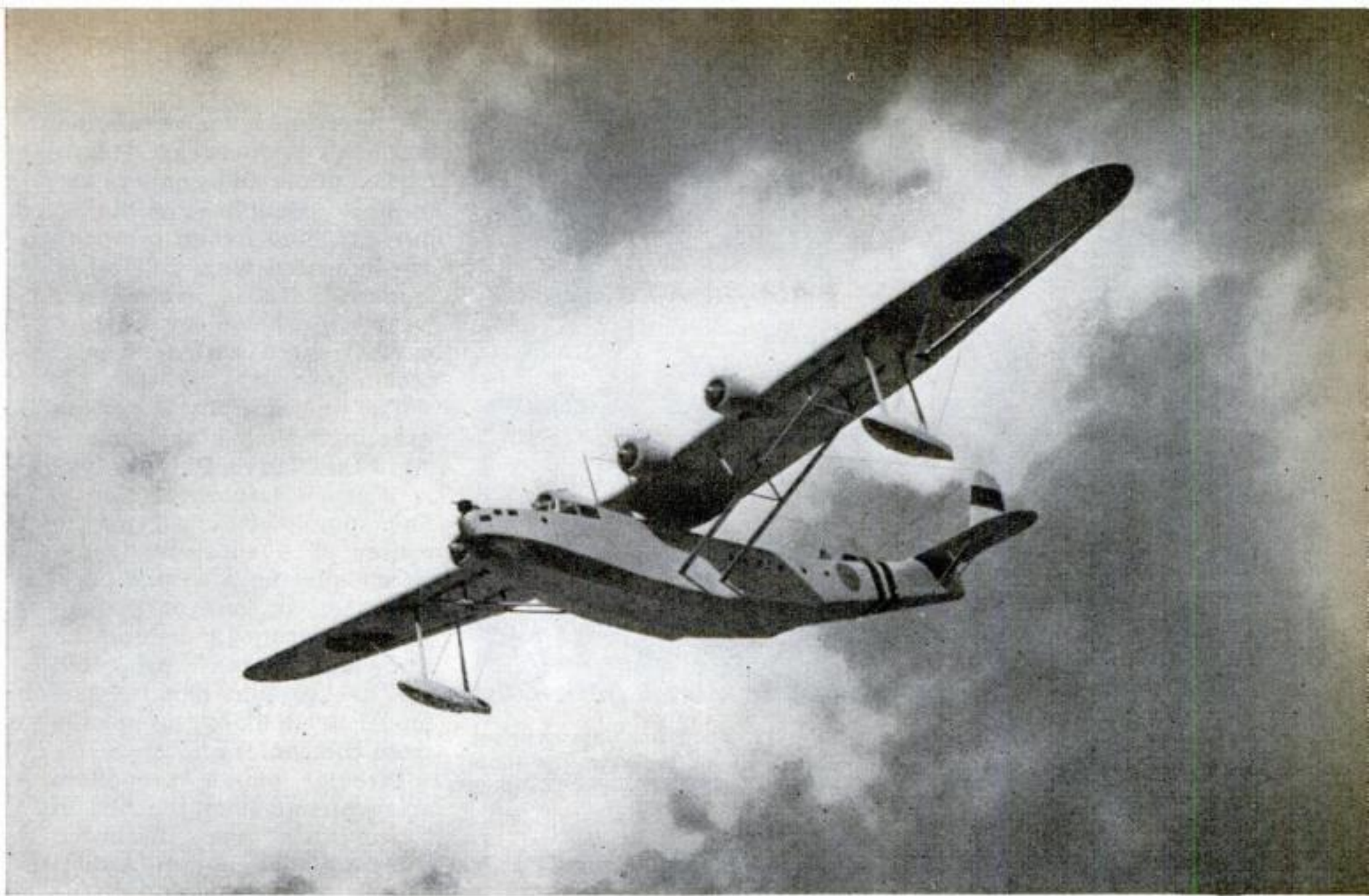
such sketchy information as a blurred photo of a wrecked enemy plane.

The Navy's shop in Washington, where most of the models are built and photographed, is a dream come true for craftsmen. In it are such tools as jeweler's lathes and gravers, electrical dental drills, burrs, and scrapers, aircraft welding torches, electrical instruments, shapers, and artist's airbrushes. Along with them are the old standbys of the home modelmaker—razor blades and sandpaper.

At the head of this shop, Capt. Luis de

Fine tools make the Navy's shop a dream come true. At left, Bob Geoghegan, an old **POPULAR SCIENCE** contributor, uses a dental burr to shape a detail on a model seaplane; center, Milton A. Stovall, turns a propeller spinner on a jeweler's lathe; right, Paul Robertson sprays a plane with an artist's airbrush.





Photographed, this model of a Jap Mavis looks like the enemy long-range patrol bomber in actual flight.

ENEMY PLANES

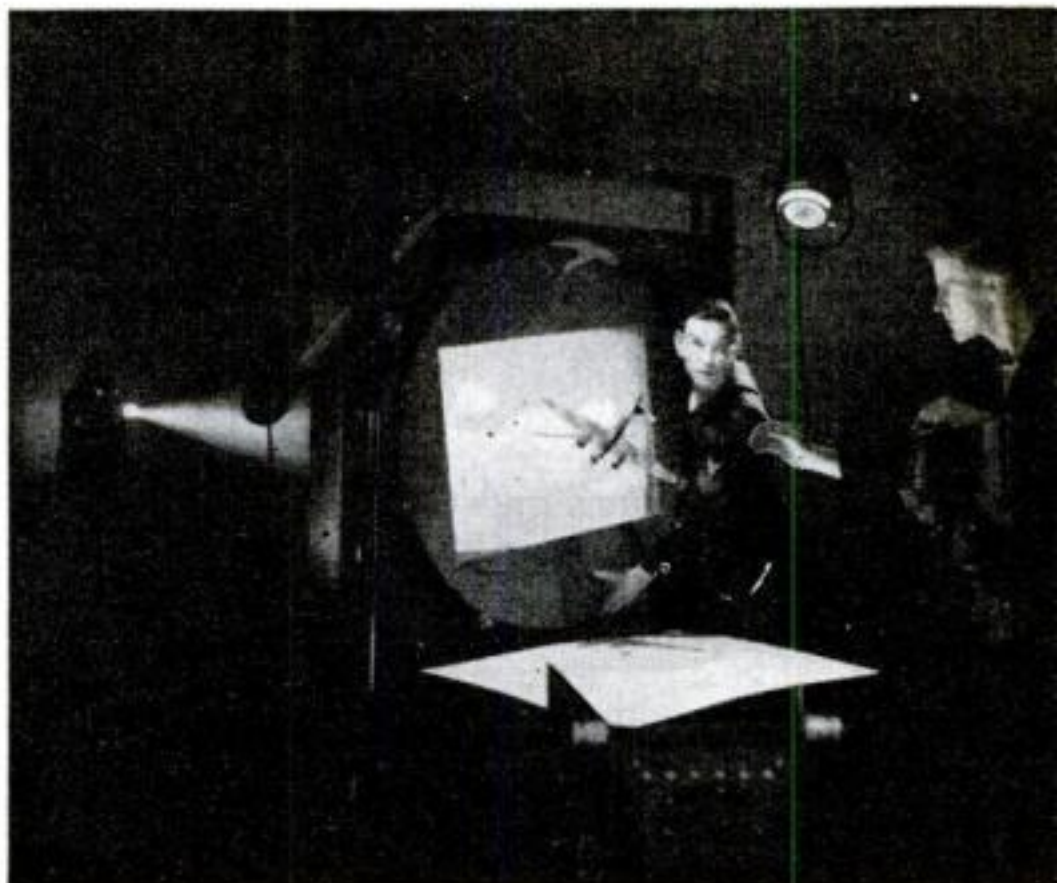
Florez, director of the Special Devices Division, placed Jim Barry, international expert on plane models who was then employed by the U. S. Treasury and is now a lieutenant in the Naval Reserve. Lieutenant Barry had had models exhibited at the Cleveland Exposition and the New York World's Fair, and many of them are now being shown at the National Museum in Washington.

Others in the Navy's model-plane shop include Petty Officer Paul Robertson, who in civilian life built small boats and homes as an occupation and model planes as a hobby. He has models on exhibit at the Smithsonian Institution at Washington.

Bob Geoghegan, another in the shop, is now an expert on ship as well as plane models. While an employee of the U. S. Trust Company in New York, he developed in his spare time an ingenious method of making sailing and exhibit ship models from paper.

[Turn the page.]

Here is how a model is photographed in the Navy's Photographic Science Laboratory to give pilots and gunners a view they will have in the air. The plane is mounted on a sheet of clear plastic, and the cloud background is projected on ground glass behind it. Below, the photographer's assistant blows on the miniature propellers to make them whirl—the Navy finds this bit of realism much more effective than plastic disks or retouching.





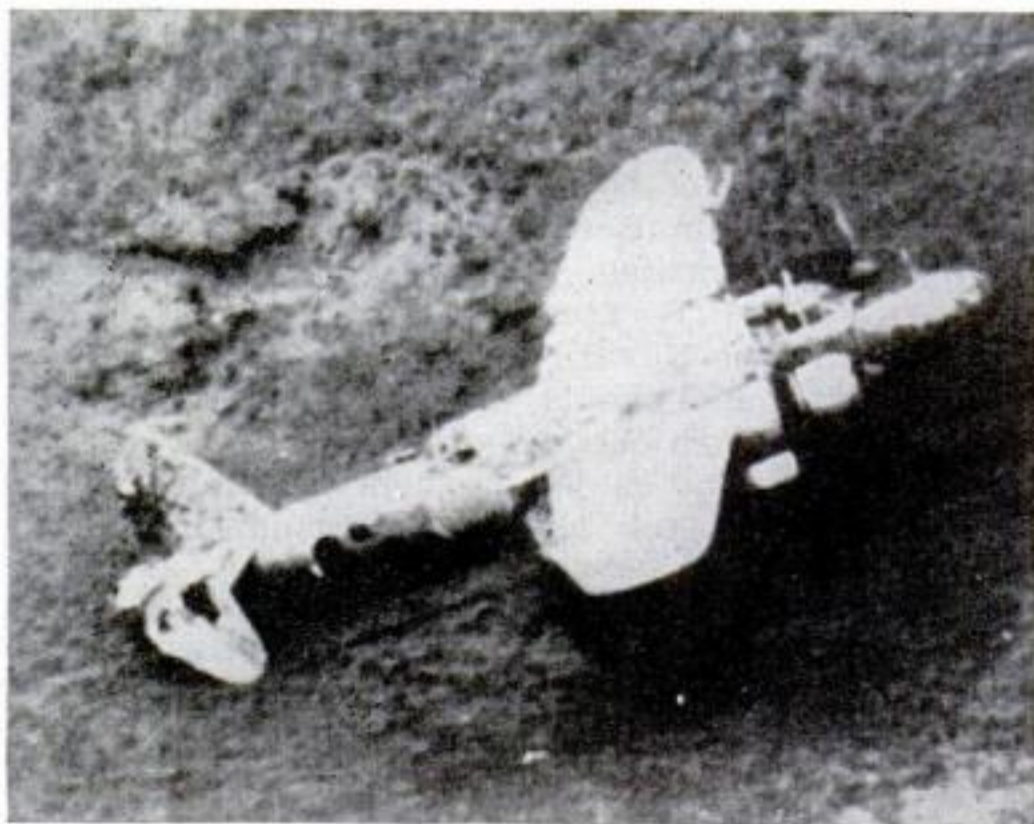
In charge of the Navy's modelmaking is Lt. Jim Barry, international expert on model planes, shown with some of his projects. The shop was set up by the Bureau of Aeronautics Special Devices Division.

Back in 1939 a cardboard model locomotive of his won an honorable mention in **POPULAR SCIENCE MONTHLY** for his U. S. Trust Company homeworkshop club, and later that same year **POPULAR SCIENCE** published a picture of an automobile engine he built.

Tom Haynes, before entering the Navy, had a construction firm specializing in wood and ornamental iron work, and his hobby was making miniature tools that would actually operate. One of his pieces is a tiny carpenter's jack plane less than 2" long and complete even to screw adjustments of the blade.

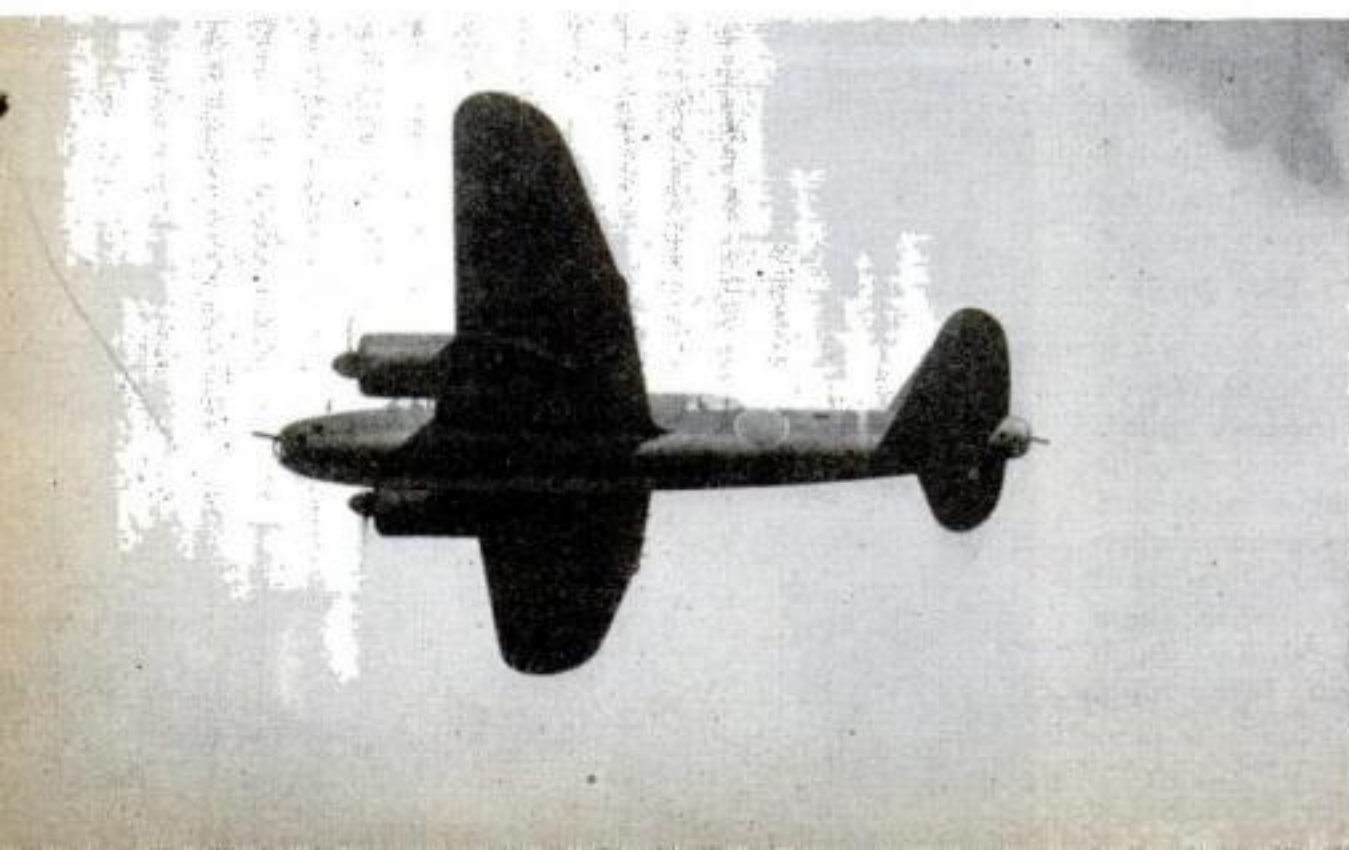
Model planes that these men turn out are accurate in every detail, often despite lack of firsthand information. Scale is frequently determined by the size of a pilot's head showing in the cockpit of a photographed enemy plane or of

long ago. They weren't real enough. Actual miniature propellers are mounted on the models. When they are photographed, a man in front blows to make them spin.



This is the way a fallen Jap Helen looks to our flyers as they speed by in the air. How would you like to try to build a model from this photograph?

It can be done. The finished photo at the left is of a model made from the picture above. All details are accurate to the nth degree, figured out carefully by the Navy's own expert craftsmen.



POPULAR SCIENCE

Speed Key for Your Lathe Chuck

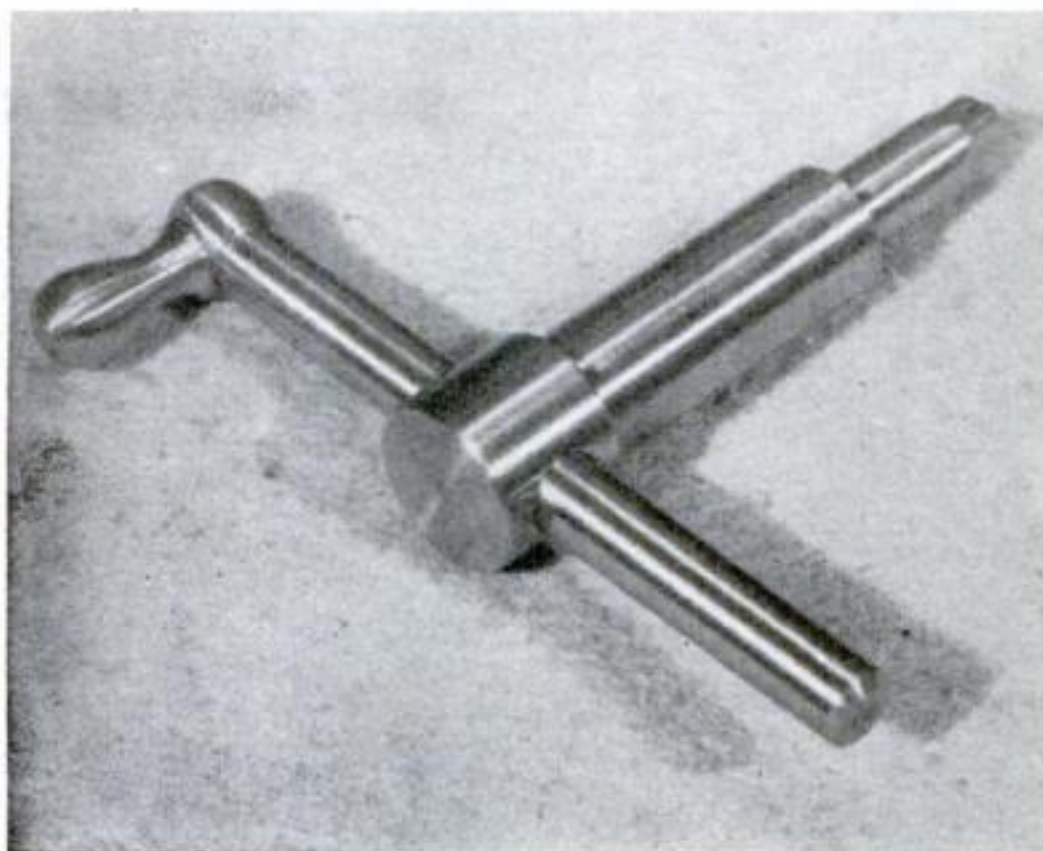
By WILL THOMAS

ADJUSTING lathe chucks is often a tedious task, particularly when the jaws of a four-jaw chuck must be removed and reversed, or when an irregularly shaped piece of stock must be chucked. While the chuck key sometimes can be spun with a finger, the jaws usually bind enough at several points to make slow hand-turning necessary.

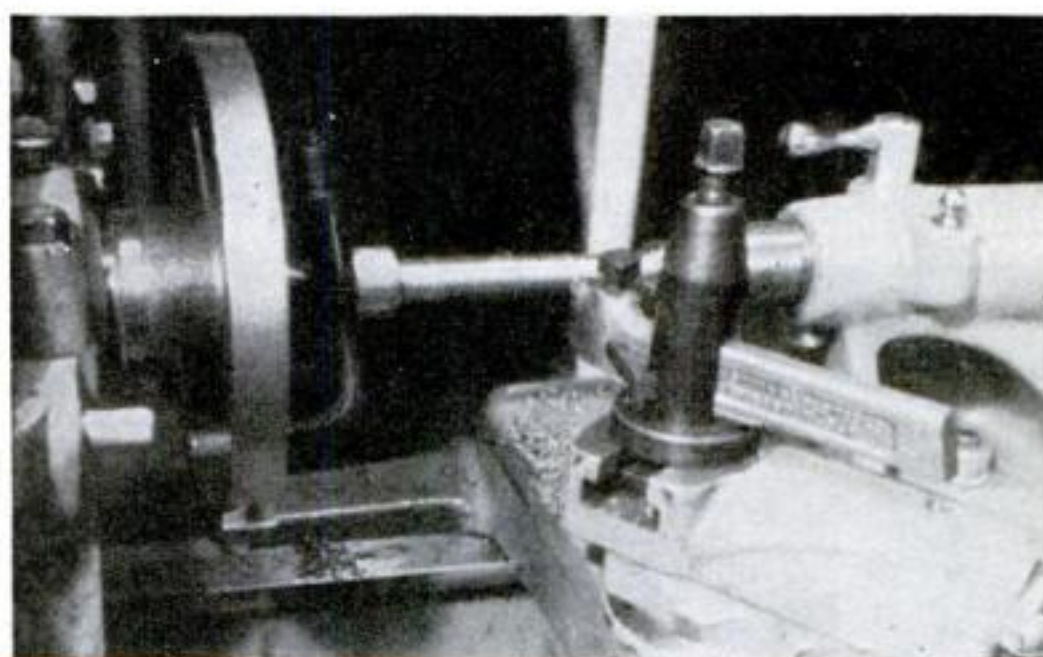
A spinner chuck key like the one shown can be made quickly from scrap steel rod. Its three parts are an interesting one-evening lathe project. No operations are difficult, and dimensions are not critical. The key provides enough leverage to spin the jaws rapidly in or out if the chuck is in good shape.

Make the shank first, taking care to form the tip to a snug sliding fit for the full depth of the chuck key sockets. If the key wobbles in the socket, it can't be spun easily. Turn the cross arm next to the shape shown in the drawing. The ball on one end is filed or milled flat and then drilled to take the spinner handle.

All three pieces may be polished in the three-jaw chuck. The cross arm is then driven through the shank, and the handle is driven on the cross arm. It need not rotate, since the smooth steel turns easily in the fingers.

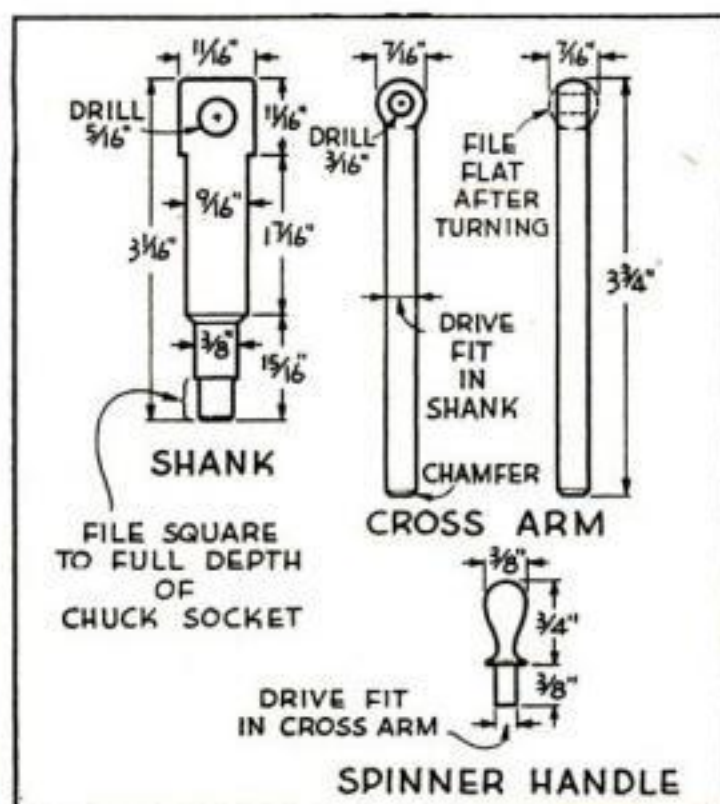
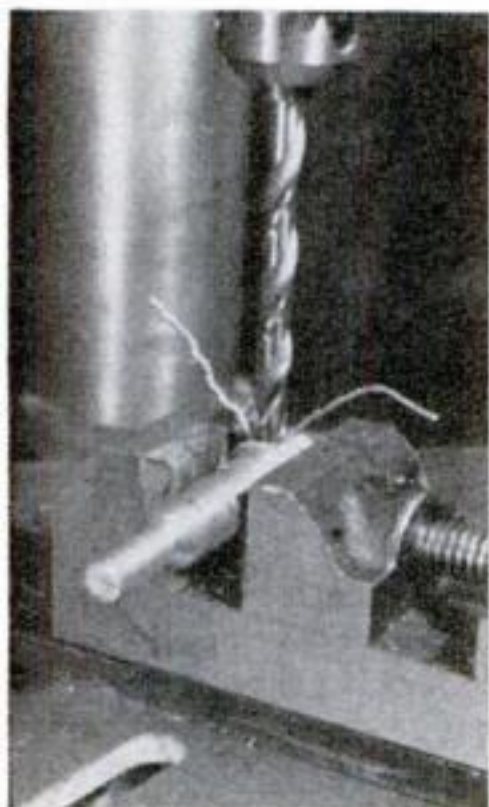


Inserted in the chuck socket, the key can be spun rapidly.

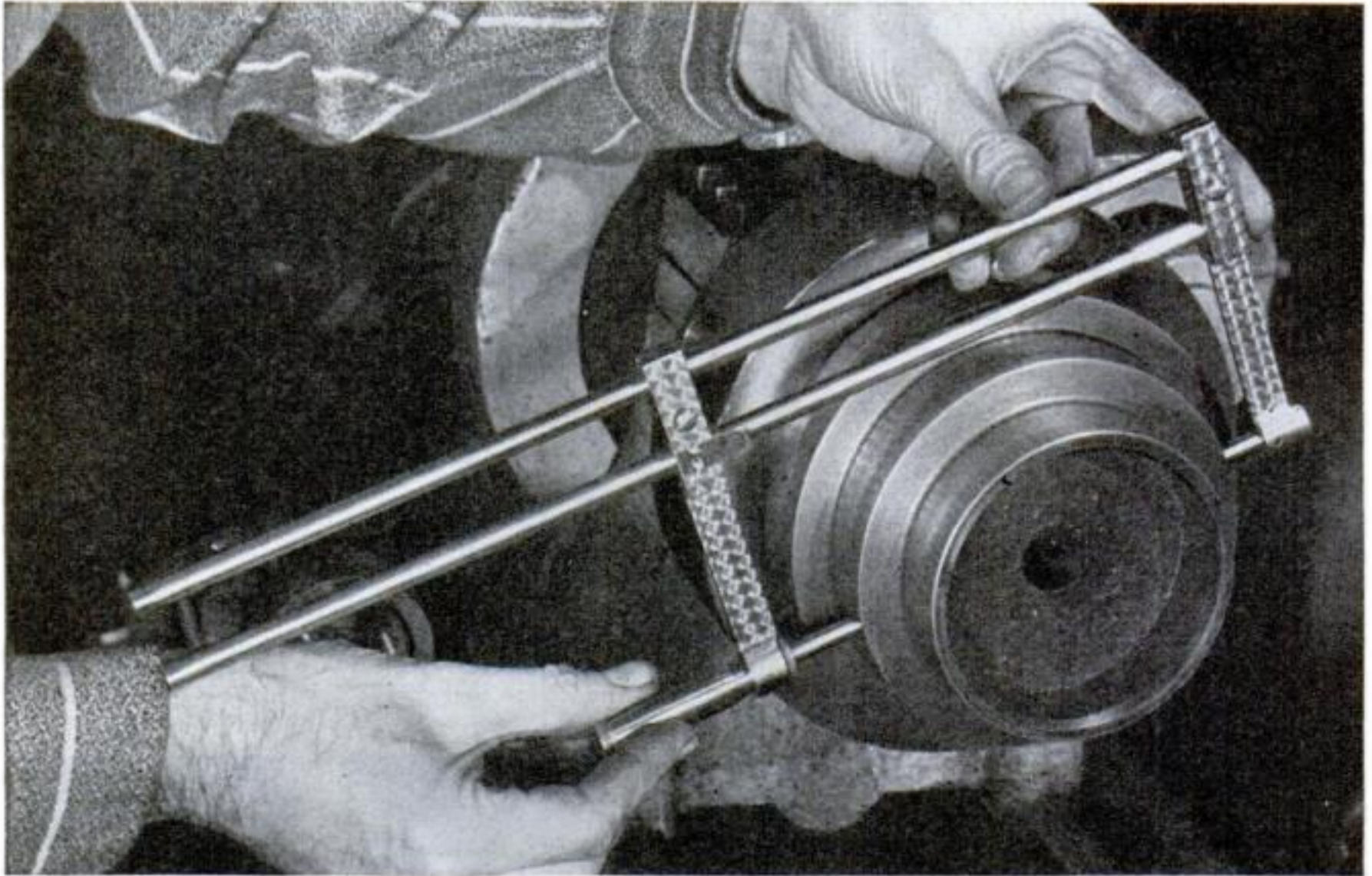


The shank is turned between centers and then cut to length.

At left, the shank is drilled to take the cross arm. The parts are shown in the drawing and at right.



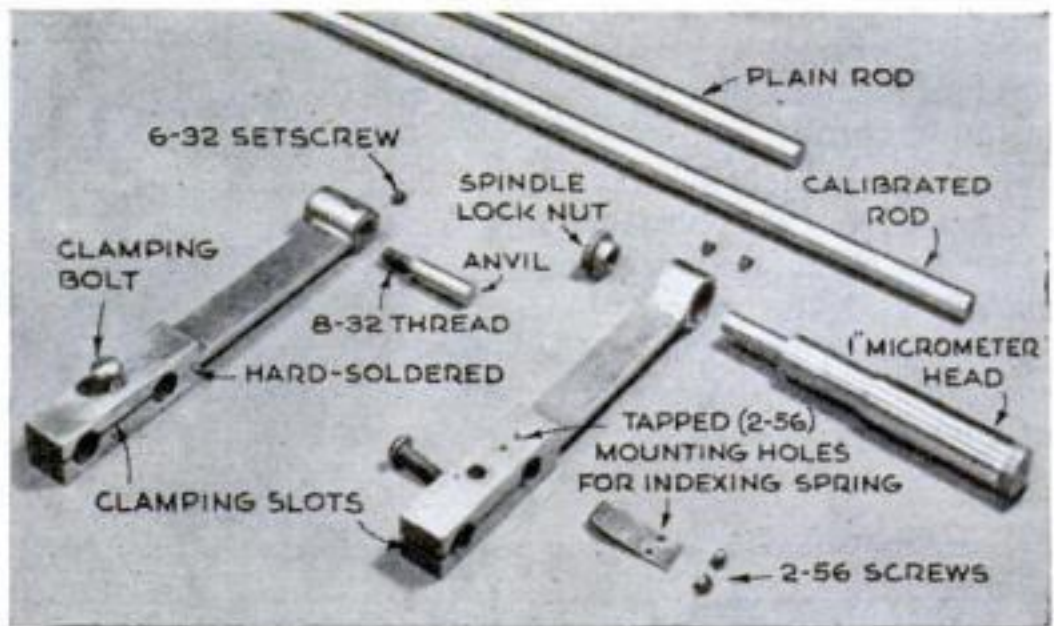
"KING-SIZE" CALIPERS



Adjusting the micrometer to check on a large diameter. The lower parallel rod is calibrated in inches.



Parts that form the micrometer and anvil arms are brazed or silver-soldered. Here sheet soldering alloy is put into a joint.



These are all the parts, finished but unassembled, that go into the micrometer calipers. Rods may be any length, but springiness affecting accuracy is in proportion to length.

By **ERVIN WALTERS**

MICROMETER measurements accurate to .001" are possible on large-diameter work with calipers you can make yourself at a fraction of the cost of vernier calipers of comparable capacity. The calipers shown also have the advantage of being able to take inside measurements when the positions of the micrometer head and anvil are swapped. Such shifting can't be done on many large micrometers.

You need two lengths of drill rod or tub-

ing for the parallel ways, a short piece of drill rod for the anvil, some scrap steel for the arms, fittings such as setscrews and clamping bolts, and a micrometer head.

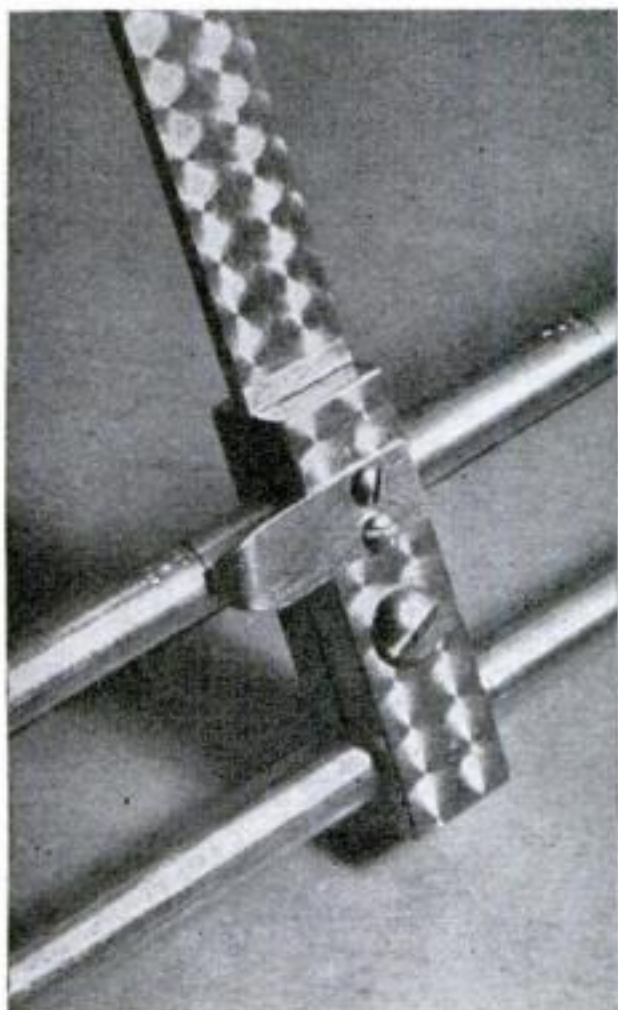
This head may be taken from a discarded micrometer, or you may buy a new head. That shown was obtained by sawing the damaged frame off a 1" micrometer. It was inserted in a collet chuck, and a mounting shank was machined on it to true roundness. If you have a choice, a head having a ratchet stop and a spindle lock will be best.

The two arms that slide and clamp on the

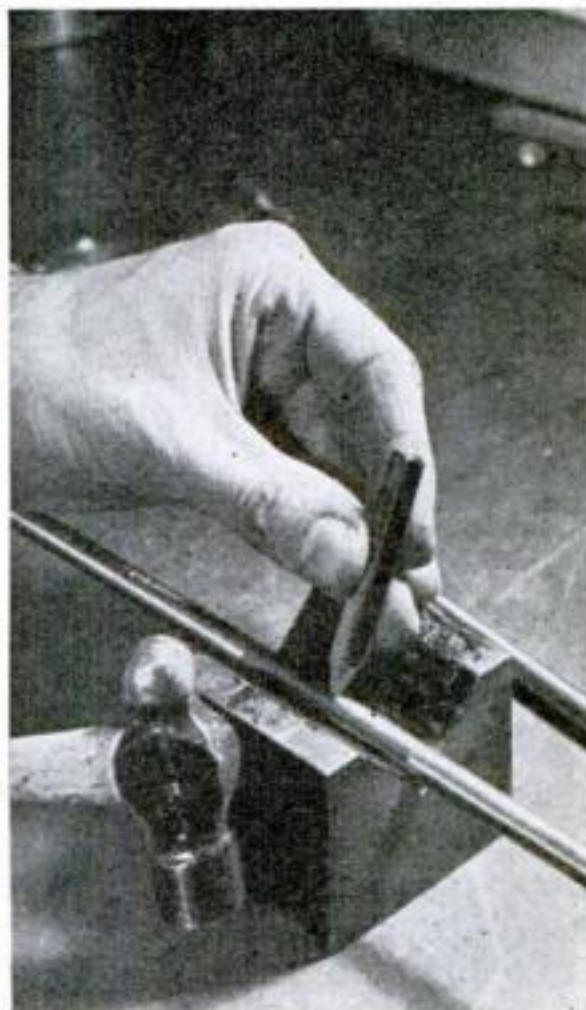
WITH MICROMETER HEAD



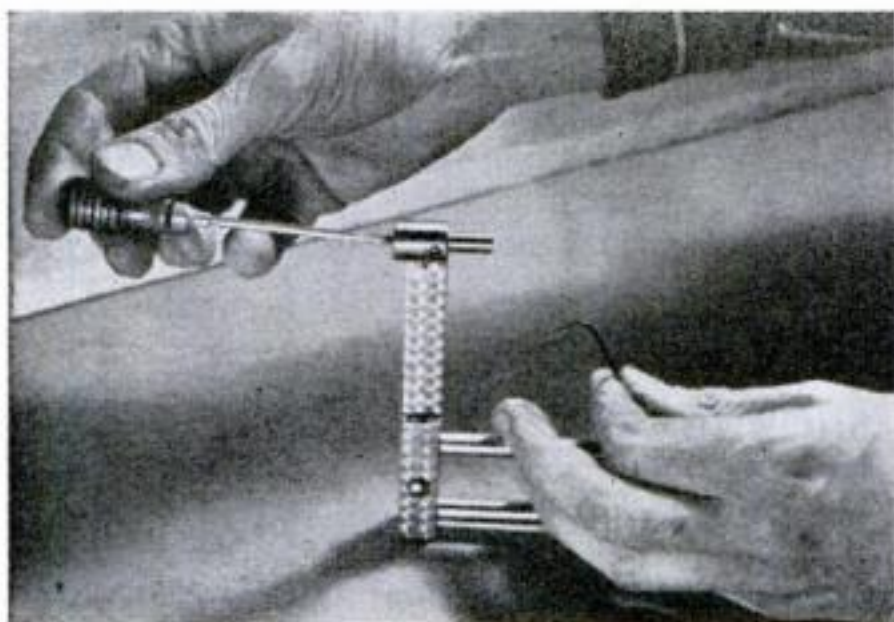
Holes for the parallel ways are drilled with the blocks clamped together. This prevents binding when the arms are being moved.



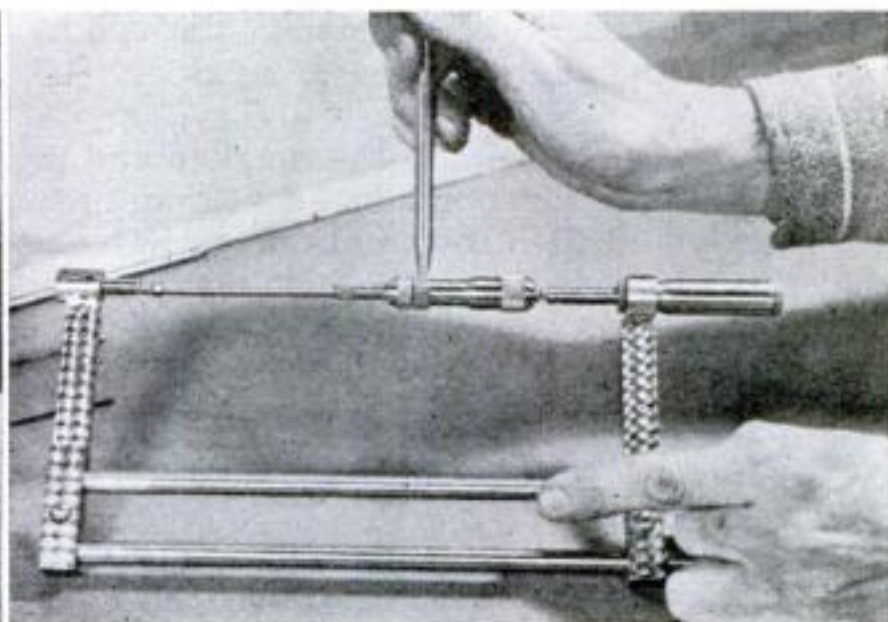
Engaging the tip of the indexing device in a calibrated mark sets the calipers roughly. The finish on the arm here is spot-polished.



Indexing marks turned accurately at 1" intervals are stamped 0-1, 1-2, and so on, indicating rough settings between the two points.



Threads on one end of the anvil and in its ring permit adjustment with a screwdriver for setting the calipers at zero. A setscrew locks the anvil.



Care in adjusting the arms on the calibrated rod assures accuracy, but precision work may require a check with gauge blocks or an inside micrometer.

parallel rods are identical except for the rings in which the micrometer head and the anvil are mounted. Arms may be machined from solid bars or built up by brazing or welding as were the ones shown. Clamp the pieces together to drill the two $5/16$ " holes so the rods will be held exactly parallel. Make the holes a few thousandths small with a size N drill and then ream them with a $5/16$ " bit or reamer. Their position is shown in the cross-section in Fig. 1.

Slot each end as shown for tight clamping on the rods. Midway between the pairs

of holes and at right angles to them, drill another hole with a No. 29 bit. Enlarge this hole on one side of the block with a No. 17 drill and tap the section on the other side to receive an 8-32 hollow-head cap screw or similar bolt.

For built-up arms cut a channel across the unslotted end of each block, as indicated in the drawing, and in it braze or silver-solder a thinner strip of $1/2$ " wide steel. To braze or silver-solder rings on the other end for holding the micrometer head and the anvil, saw a short split in these ends and

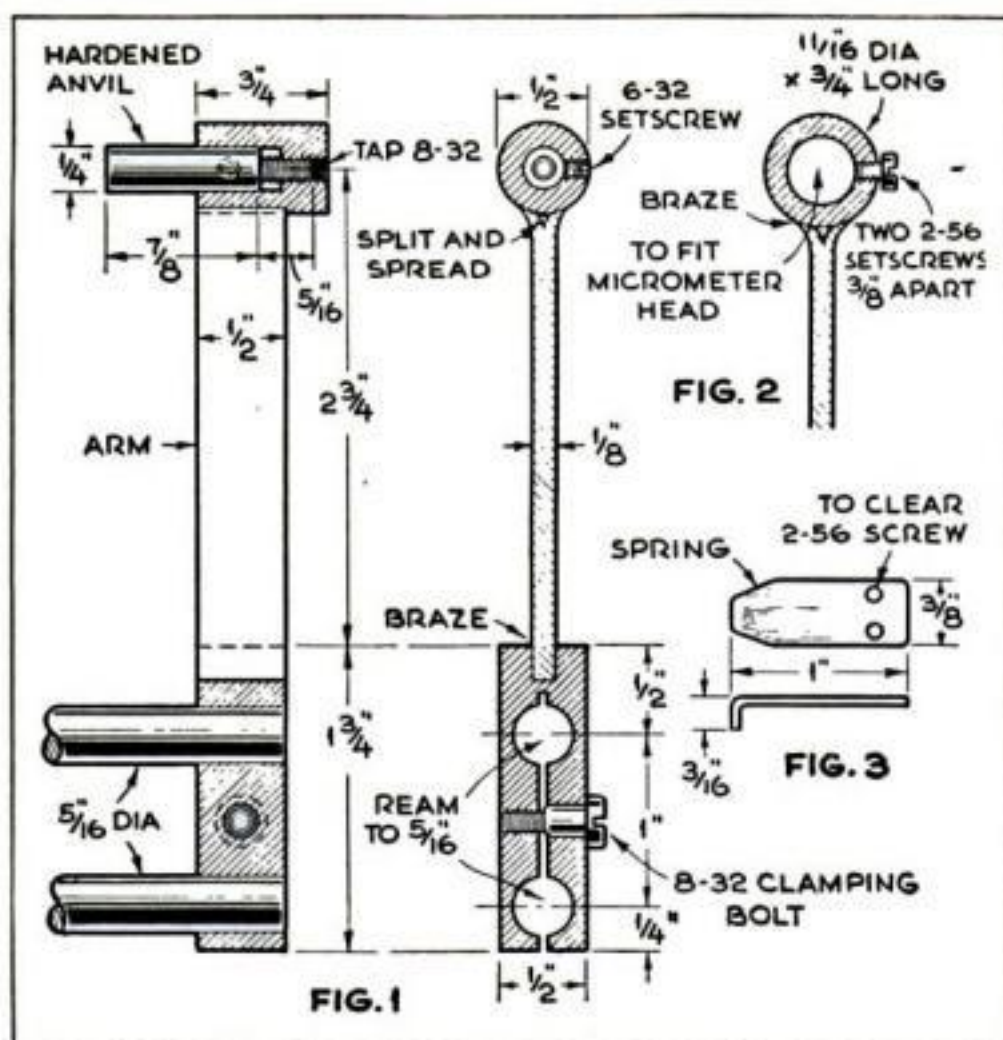
spread them to a Y shape, as shown, with a cold chisel or similar tool.

Turn and drill the rings to the dimensions shown—in Fig. 1 for that holding the anvil and in Fig. 2 for the micrometer head. The walls of the latter ring must be about $\frac{3}{32}$ " thick to take the two setscrews. One well-known head has a shank $\frac{3}{8}$ " in diameter and $\frac{3}{4}$ " long and another a shank $\frac{1}{2}$ " by $\frac{3}{4}$ " long.

The anvil is designed so it can be moved to set the micrometer at zero and is locked with one setscrew. Turn one end down and thread it to fit the 8-32 tapped hole. A slot may be cut in the threaded end to receive a screwdriver, or a knurled collar may be provided somewhere between the tip of the anvil and the arm. Harden the finished anvil and draw the threaded portion to a bronze color.

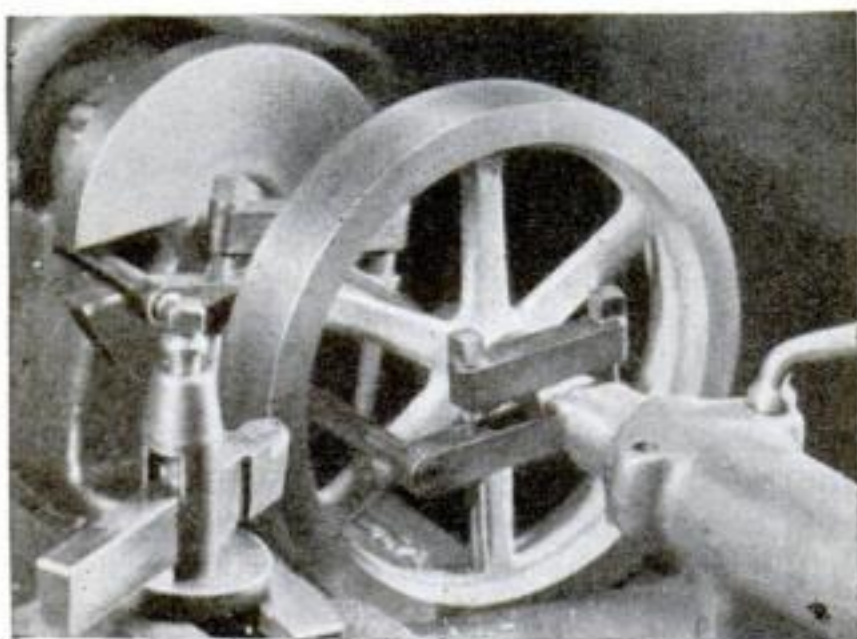
Figure 3 shows a flat, stiff spring for attaching to the micrometer-head arm to assist in rough setting. Its short edge acts as a pointer, engaging shallow grooves turned in one of the rods. Determine the starting point for these grooves with the micrometer assembled and the anvil arm clamped at the extreme end. Move the micrometer arm in to where, when the micrometer is set at zero, the spindle and anvil will just touch. Mark the point at which the spring bears against the rod.

Remove the rod, clamp the marked end in a lathe collet or dog, and run a center against a center hole drilled in the other end. Use a sharp tool to turn a groove .006" deep at the



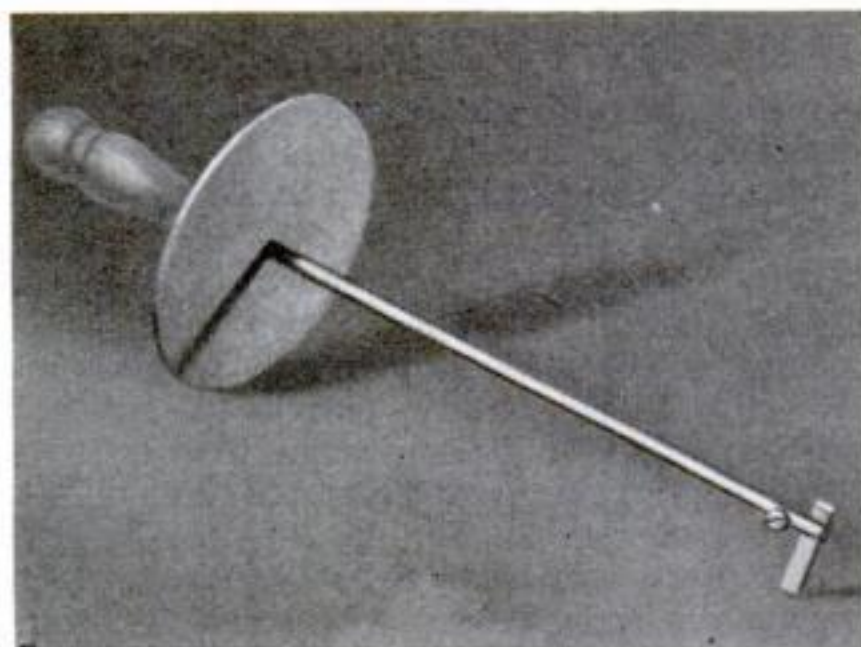
mark. Move the lathe carriage exactly 1" and cut another groove, and continue until the entire length has been grooved at 1" intervals. Number the calibration marks 0-1, 1-2, 2-3, and so forth to show between what limits the micrometer is reading.

Make certain that the spindle and anvil line up properly. If they don't, bending or twisting the arms slightly may help. The rods may be as long as required. Allow for springiness in taking a measurement by adjusting the spindle until it just touches the work.

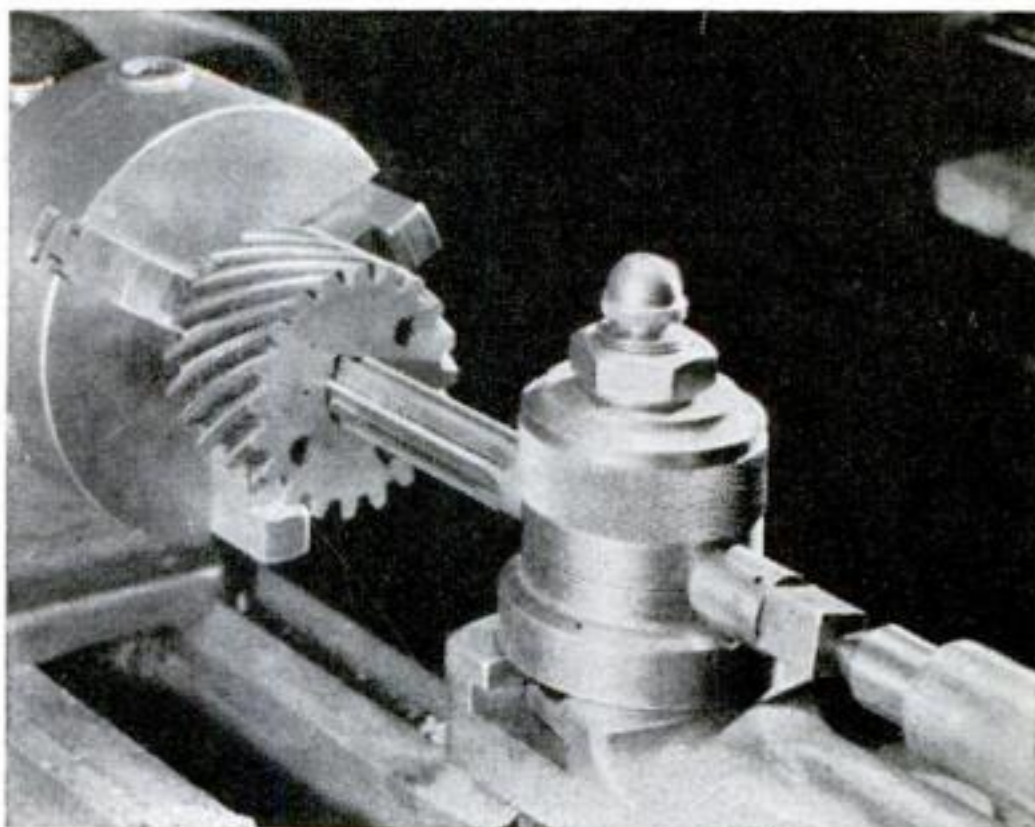


HEAVY LATHE CUTS are possible on large-diameter work if an additional lathe dog is used on the mandrel to engage the work and keep it from slipping. As shown above, one lathe dog is used in the customary way, while a second engages the work.

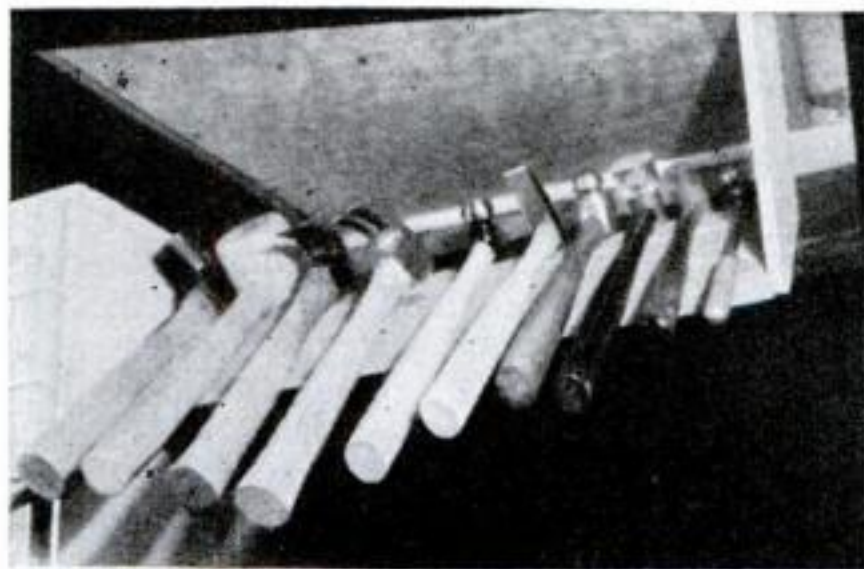
SHORT BRAZING STRIPS can be held safely in a slot sawed in $\frac{1}{4}$ " steel rod. Drill a No. 29 hole, tap 8-32 on one side of the slot, and open it on the other to clear a clamp screw. A file handle and fiber guard complete the holder.



DRILLS AND REAMERS having straight shanks can be clamped in the boring-bar holder on the lathe carriage and fed to the work automatically by use of the power feed. Or, similarly clamped and supported in addition by running the dead center against it as shown in the photo at right, a reamer can be kept from turning as it is fed to the work with the tailstock handwheel. In this case, the carriage must, of course, be free to move along the ways. Drill and reamer shanks of too small a diameter for the boring-bar holder may be held securely by the use of split bushings which will give the clamp a good binding surface.—C. W. WOODSON.

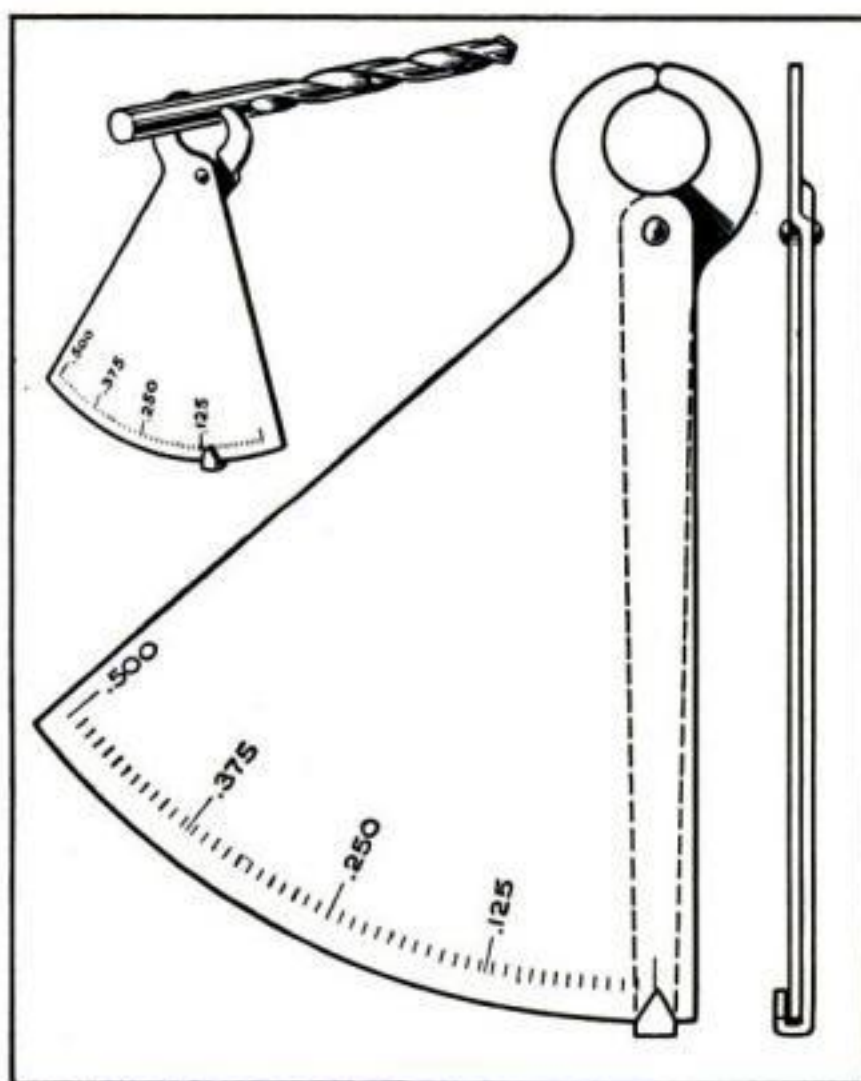


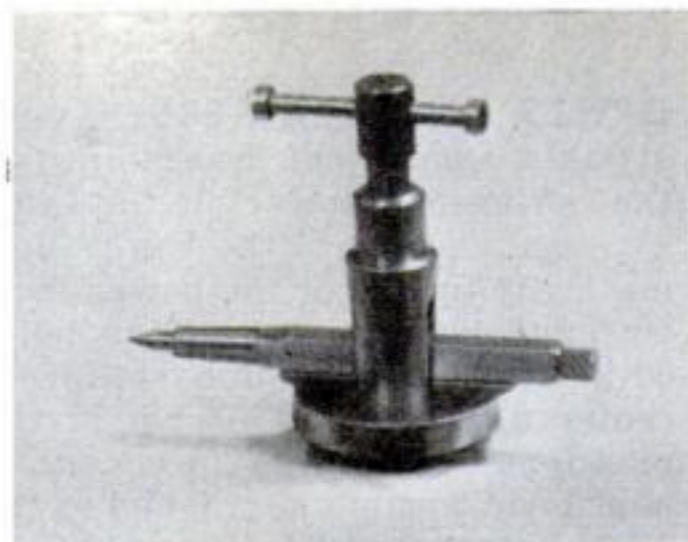
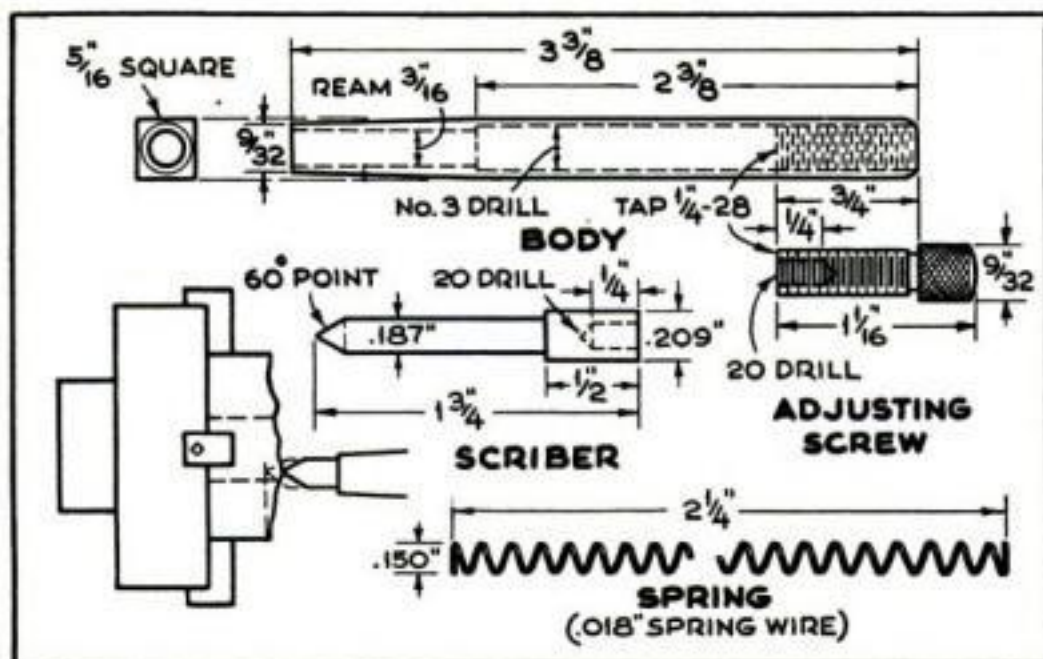
HAMMERS RACKED over the bench will be within handy reach and yet will be out of the way when not in use. The rack shown below is made from short lengths of 6" board suspended from the ceiling at an angle of 45 deg. Heads of hammers and mallets are hooked loosely in rounded notches cut in the edge by a shaper, jigsaw, or coping saw. About 2" between notch centers leaves room for grasping the handles. Make the rack long enough for two or three extra hammers you may get later.—W. T.



BROKEN HIGH-SPEED DRILLS that are ready for the discard can be formed into serviceable lathe tools. Grind a flat face for the entire length of a countersink or center drill to provide a surface that can be held firmly in the lathe tool holder. Then grind a cutting point to the standard shape required for the particular work for which you want the tool. Round-nose, diamond-point, and threading tools can be ground and shaped in this way.—D. S. GREENLAW.

QUICK MEASURING of drill, bolt, and screw diameters is possible with a gauge made and used as shown below. Both sections are cut from a scrap of sheet metal. Part of one forms the sector of a circle with a radius to the riveted joint; the other tapers to a point that is bent over to serve as a pointer on a calibrated scale. Close the caliper legs and mark the zero exactly at the pointer. Calibration may then be done with gauge blocks or a set of drills of known sizes, and the scale marked in thousandths or in drill sizes.—IRVING ZEICHNER.



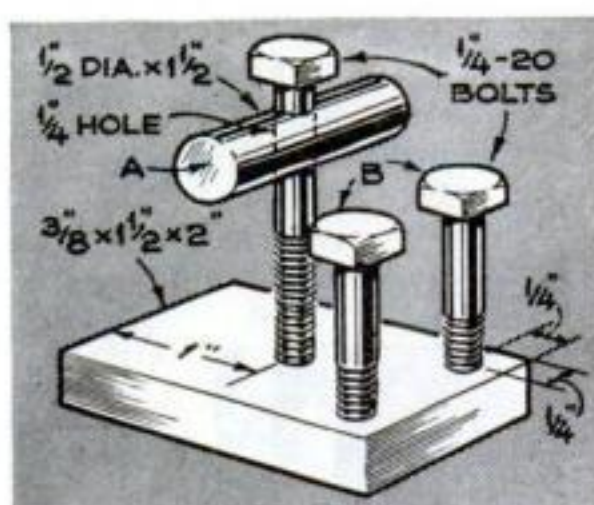
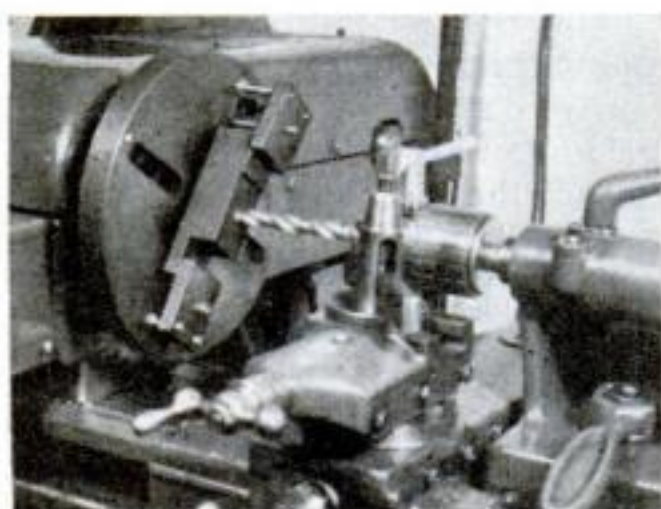


SCRIBING LATHE LAYOUTS is simplified by this spring scribe that can be clamped in the toolpost for smooth, irregular, or rough work and high or low-centered pieces. For smooth work, start the lathe and bring the scriber to bear with a slight compression; but for irregular or rough surfaces, turn the lathe by hand.

Cut the body from 5/16" cold-rolled steel or key stock. Set it up in the four-jaw

chuck, turn a slight taper for 1" at the end, drill a few thousandths under 3/16" for slightly more than 1", and ream to 3/16". Reverse the piece, drill 2 3/8" deep with a No. 3 drill, and tap 1/4" -28 3/4" deep. Chamfer the corners.

Make two scribers of drill rod, one 1 3/4" long as shown and the other 2 1/8" with an identical butt. The No. 20 holes in the scribers and adjusting screw take a spring wound of .018" wire on a .095" arbor for a sliding fit. Harden the scribers and draw to a straw color.—HENRY W. HALLIGAN.



A on the long bolt engages the underside of the faceplate slot so the clamp plate can be pulled up tight against the work. It is cut from 1/2" drill rod and then drilled a free fit on the shank of the bolt.

In use, the two bolts B are drawn up to the approximate thick-

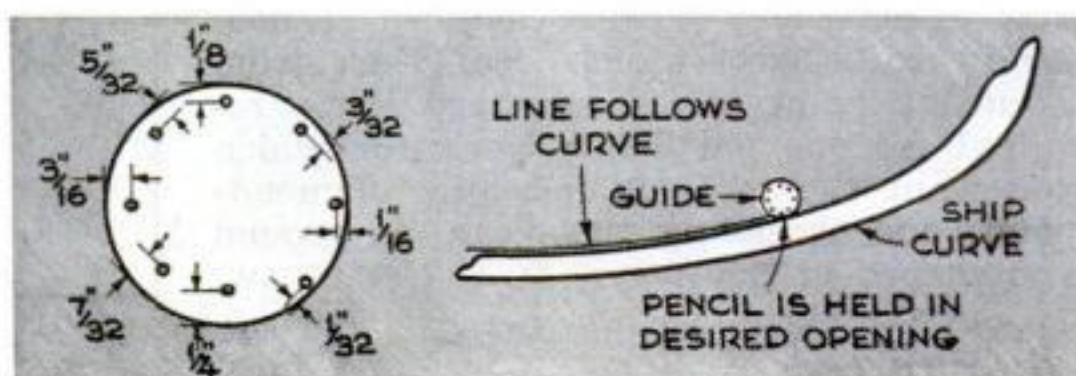
ADJUSTABLE CLAMPS will hold both flat and irregular work firmly against the lathe faceplate. A pair will be sufficient for most pieces, but rounded surfaces can be held if four clamps are used.

Cut the clamping plates from scrap steel and drill and tap them for three 1/4" -20 bolts as shown in the drawing. Crosspiece

ness of the work. The long bolt is inserted from the back of the faceplate with A at right angles to the slot and is drawn up finger-tight. Bolts B are backed up for final tightening. Three sets of bolts of different lengths should take care of work 1/4" to 3" thick. Sheet copper under the plates will protect finished surfaces.—AUGUST DOBERT.

PARALLEL CURVED LINES on shop layouts can be drawn quickly with a guide made of a metal or plastic disk. Holes for a pencil point are drilled at various distances from the edge. With a draftsman's curve, a template, or a loftman's ship curve laid on the original curved line, the pencil is put through the guide hole affording the spacing wanted and run along with the disk bearing against the edge of the

curve. As the guide is held by pressure against the edge of the curve, it cannot rotate and the two curves will be exactly parallel.—T. DASH.





FOR SAFETY'S SAKE, this band saw in the Army Air Forces woodworking shop at Stewart Field, N. Y., has been fitted with a special Plexiglas shield through which the blade is visible. The shield guards the worker from injury but does not interfere with operation of the saw. This and other safety devices have reduced the accident record at army posts about 50 percent.

HAND TAPPING of holes in aircraft parts has been vastly speeded up by Staff Sergeant Erik Peterson, of Springfield Gardens, N. Y. He designed a metal base on which a curved arm holds the tapping tool in position and allows it to be turned with a handle. The piece being threaded is clamped to the base in such a manner that the tap and hole are always in alignment. In addition to increasing output, the method reduces tap breakage.



METAL SHIELDS slipped over the louvers eliminate tedious masking when paint of a different color is being sprayed over the woodwork around a ventilator. Devised by Arthur St. Clair Martin, of Santa Monica, Calif., these covers may be formed of aluminum, easily cut to the exact size of the louvers. When the door is reversed, a metal cover protects the other side of the ventilator.



TWISTING THE ENDS of coil wires with an inexpensive device, developed and now being used by workers at the North American Aviation Company's plant at Dallas, saves approximately 15 minutes in winding a single armature. The tool consists of two 12" lengths of spring-steel wire twisted together in even spirals. When a worker slides a disk of scrap Plexiglas back rapidly on this spiral wind, the tool rotates at high speed, twisting the coil wires in quick order. The coil wires are gripped with a prong made by bending the ends of the steel wire 90 deg.



RIVET DISPENSING is considerably simplified by this rotating device, designed and built by John W. Burgeen, an employee of Consolidated Aircraft Corporation. Rivets of various sizes go into a partitioned tray when the latter is rotated by means of a handle to bring the various compartments into line with an aperture in the cover. Once inside, the rivets are identified by numbers on the outside of the tray. The dispenser was made by riveting together several pieces of scrap metal. When in use, it is attached to a convenient post.



It's All in Your Point of View

FROM WHERE YOU AIM, AS MUCH AS AT WHAT, MAKES A PICTURE

By Florence C. O'Connor

NOT so much what your camera sees, but how it sees it, is often the difference between a salon photograph and just another snapshot. Views that draw "Ah!" when first seen by the eye all too frequently prove disappointing when transferred to a print. This is because the eye is extremely mobile and takes in great spaces at a glance, while the camera lens is limited by a frame.

And yet, the average amateur could avoid most bad pictures if he would only give a little thought to point of view before he clicks the shutter. Aiming a camera at any object that appears before it is not making pictures. Like a good story, a picture must make its point. In order to present the scene so it will tell its story best, the position from which the picture is taken must be chosen carefully.

The scene is a stationary object surrounded by space in three dimensions: height, depth, and circumference. You have three ways of changing the point of view: you may raise or lower the camera to change height, you may get close to or far from the object to affect depth, and you may photograph it from any side. Raising and lowering the camera will affect the horizon line; the distance between the camera and the subject will control perspective, radial lines, and emphasis; a shift on the circumference will change the massing of the component parts. Physical conditions may limit your choice, but you will always have more than one.

Picture taking is a slow business and requires patience. If Aunt Jenny is perturbed by having to sit in the hot car while you walk all around an old tree, it doesn't help.



"Abandoned," and the forlorn house framed by unkempt trees really looks so above, but at right, with more foreground, its interest is secondary to that of the rotting bridge.



Go on your picture-taking trips alone or with a sympathetic companion who will carry the tripod, hand you filters, and do other odd jobs.

Unless you know what you are looking for and can recognize it when you see it, walking around a subject won't help. You must first learn a few rules of design and composition, and how to utilize point of view to help achieve a well-composed, strong picture.

Suppose you come upon an interesting small house shaded by a tall, stately tree and a picturesque barn that seem to have the elements of a picture. You could take it as shown at *A* in the drawings on page 169, but you would not have a picture. The elements from that point of view have no relationship. They make three pictures, one of the tree, one of the house, and one of the barn. All may have interest, but individual interest must often be sacrificed for collective interest. A shift of the point of view—a few yards to the right or left, nearer or farther away, higher or lower—will change massing, perspective, and horizon.

Try shifting the point of viewing the tree, house, and barn. Lowering the camera and the horizon line may give you the result at



B; raising them may give the one at *C*. Neither is good. Retreat a few yards, and the result will be something like *D*—still not good. But walk around the group until the three units are massed together, get close enough for the mass to take up most of the picture space, lower the camera to give height and grandeur to the scene, and you get a well-composed picture like that at *E*.

If you ask, "Why am I taking this picture?" you might well answer, "Because here is a farm, symbolic of life itself—nature in the tree, protection from weather in the house, a means of survival in the barn." To get this universal theme across to your neighbor, or to a man from Persia who might see your work, you must eliminate

Both groups of trees at left are good pictorial subjects, but in one photo they detract from each other. Above, taken from a slightly different angle and allowing space for towering clouds, the broken tree makes a real picture.

all suggestion of a specific place. The scene must be symbolic of every farm. There is no need to show the paved road, the R.F.D. box with the farmer's name on it, or the sign on the side of the barn.

Space relationship, line, massing, tone, and light and shadow help the composition of your picture. The first three are all governed by point of view. Tone and shading depend largely on lighting and exposure, but point of view can help them, too, to some extent, for it has control over shape, depth, and direction of shadows.

What point of view alone can do is clearly illustrated by the accompanying pairs of pictures. A problem of concentrating interest on the main theme is solved in the pair on page 166. At first the overgrown trees and the rotting bridge seemed to be part of the story of the deserted house. Their inclusion, however, set the house too far back and made it insignificant, a secondary instead of a primary interest. The mass of branches also added to the confusion. Taken from a spot about a third of the way up, the old house got the prominence it deserved, and "Abandoned" was the happy result.

Space relationship and massing are bad in the photo of the two groups of trees at the bottom of page 167. Here was a situation where both elements had photographic possibilities, but you can have too much of a good thing. Two spots of interest weaken a picture to the disadvantage of both. I realized this as soon as the shutter had clicked, and decided that the old broken-

down tree had most appeal. A shift of the point of view to one side and a few steps forward massed the tree against the sky and filled the picture space as I wanted it. I then lowered the camera, shifting the horizon to lessen the foreground and play up the thunderous sky. The result, "Defeated," was a satisfying picture.

Horizon and sky line are sometimes confused by photographers. In ordinary language they are the same, but in photography, as in drawing and painting, the horizon is the line on the scene level with the eye—or with the lens in photography—while the sky line is where land and sky meet. In "Defeated" horizon and sky line are about the same.

Somewhat the same situation as that of the tree, house, and barn in the drawings occurred in taking the photos of the lily pond. The owner wanted to show as much as possible. Only in the finished pictures could I convince him that part of a scene can signify the whole.

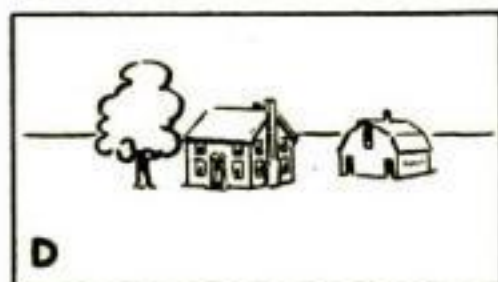
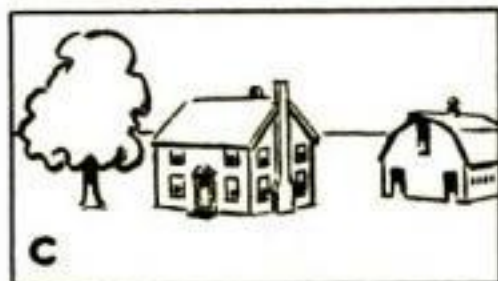
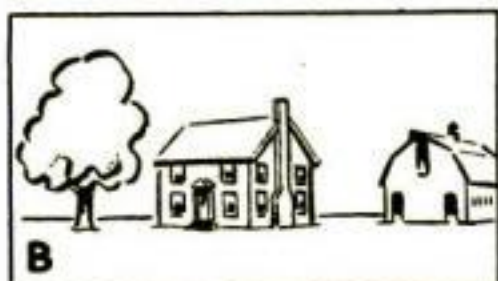
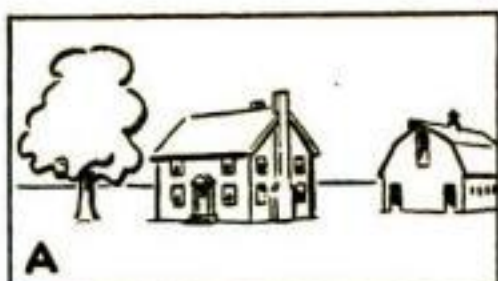
To please him I made an exposure straight across the pool. The welter of confusion of objects, reflections, and light obliterated the bronze goose of which he was proud and would not let the picture hang together and tell its story.

Then I walked around the pool, perched precariously on a rock, and aimed at the bronze goose from a low side angle. (Don't forget that lowering the camera is vastly different from tilting it.) Most of the background was eliminated, only enough of the



Too much of a good thing often causes confusion, as at right with a welter of objects, reflections, and light. Above, with the bronze goose as the point of interest, the picture presents more by showing less.





From a sprawling scene to a charming grouping sometimes takes but a few steps. The lower photo at right lacks cohesion and the river is lost in the foreground, but note the difference at top. One building is left out, a smaller one is added, and our river becomes effective. The drawings above show how change in the point of view can affect the composition.



rocks and flowers being shown to suggest a rock garden. Lily pads and reflections were no longer confusing, and the diagonal line of the pool made for good composition.

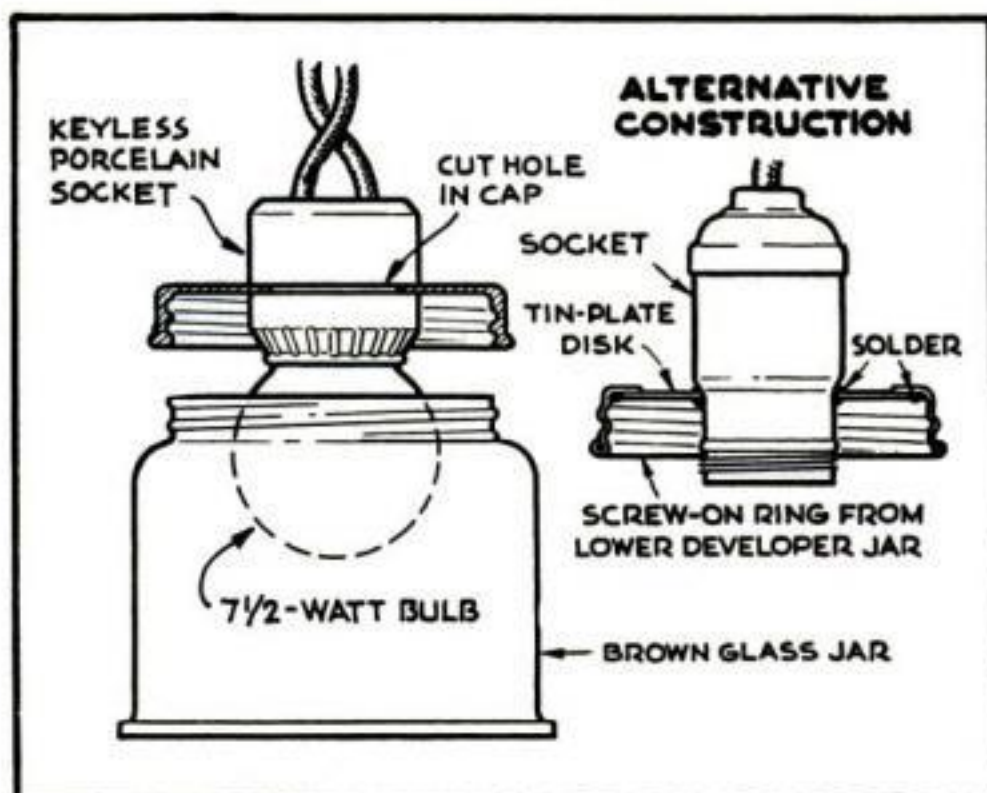
On the outskirts of a small town bordering a tranquil river, the afternoon light on two mill buildings fascinated me as did some little houses on a hill. But after I had taken the lower photo on this page, I realized what a sprawling scene it was and that by getting the houses on the hill I had sacrificed the river and a charming foreground.

A few steps to the right and a shift of the camera downstream resulted in the picture "River's Edge" on this page. The big building on the right was eliminated, but the small building to the left was gained. It helped balance the main building and gave

a pleasing repetition of shape and form. Old fence posts added foreground interest.

You need not have a camera along with you to practice choosing points of view. Carry a small card with an opening about 1" by 1½" cut in it. Use this as a view finder by holding it in front of one eye and framing your picture with it. Or use a window frame in your home or office or the windshield of your car. Watch how things change as you drive along. You will soon find yourself selecting and rejecting the compositions framed in your "finder."

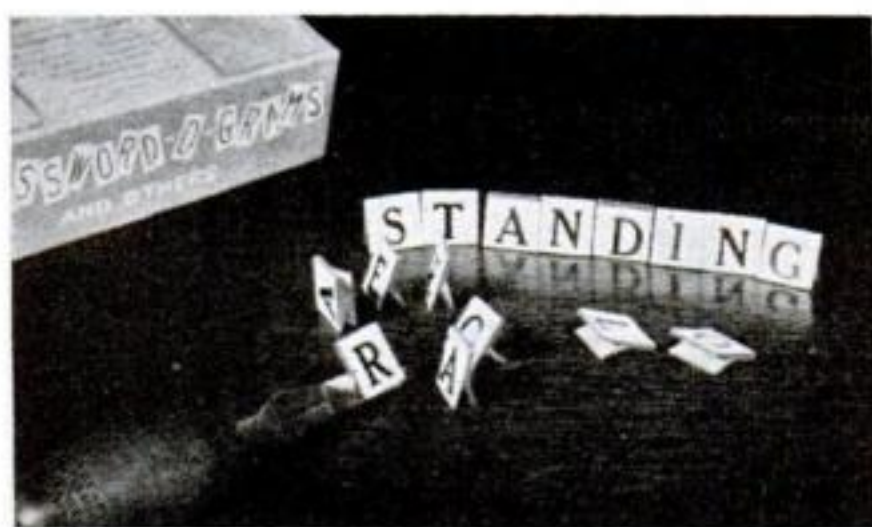
Then when you are on a picture-taking trip you will accept and reject viewpoints automatically, so that when you get your camera out you will have boiled down the possible viewpoints to a few good ones.



PRINTING SAFELIGHTS can be easily contrived from the two-section brown jars in which developing chemicals are sold. Either section is usable if the jar is one of the larger sizes. Otherwise, the top jar may not have sufficient space to accommodate the bulb. If it has, cut a hole 1 3/8" in diameter in the metal screw-on cover. Then secure the cap between the two parts of a porcelain socket or solder it to a brass socket. When the bottom jar must be used, cut a tin-plate disk just large enough to slip into the metal ring around the top. Make a hole in the center of the disk, slide it over a brass socket, and solder to the ring and socket.—DAVID KOSAKOFF.



ANAGRAM GAMES made of cardboard are a good source of letters for home-movie titles. Numerals are lacking, but these can be cut from a calendar and pasted on heavy cardboard. The anagram letters will stand upright if back supports are provided by splitting the cardboard from the bottom up-



ward and bending at an angle. Adhesive tape will hold them in place on an inclined surface. Focus a spotlight on the title words to make them stand out from whatever background objects are used. A medium-speed panchromatic film is best for photographing titles.—C. F. TREVELYAN.

EACH ROLL of 35-mm. film that I shoot now is branded with my name and address. Some time ago I sent my developer a roll with some potentially good shots on it. I still am wondering whether they were really good, for somebody else's film was returned to me. Now I devote one exposure of each roll to this sign.—W. C. F.



WEIGHTED by its cast-iron base, a stand made from the bottom section of a movable street-department or filling-station sign will support a heavy studio camera without danger of tipping over, yet it can be easily rolled to a new position. Add a telescoping riser, clamp tee, and a locking handle to the standard, and then top off the whole with a floor flange and a tilt-top. The heavy construction prevents vibration if the floor is even.—I. G.

POPULAR SCIENCE



RIDING A ROCKET? That may be what the young woman above appears to be doing, but the illusion was created by an ingenious photographer with only a few props. How he did it is shown in the photograph at the right. The rocket, consisting of a cardboard cylinder and nose mounted on a two-by-four 16' long, was suspended from the framework by fine wires. A sense of height was obtained by taking the picture at an upward angle so as to include only the tips of the palm branches. The smoke and flame spouting from the tail might be produced by retouching or by mounting a small rocket firmly in the cylinder and firing it just before the exposure is made.



FORMULAS for both films and paper are quickly found on this chart, produced by the Reed Manufacturing Co., of Los Angeles, Calif. The dial is turned until the developer wanted appears in the small window at the top. The numbers that show in the long opening directly below represent the amounts of chemicals needed for that developer. On the face of the chart adjoining this opening the chemicals are printed in the order of mixing.



SPEEDY film development in five to 11 minutes is claimed by Swain Nelson Laboratories, Inc., Glenview, Ill., for QSE ultra-fine-grain developer. Their QSE Royal Toner gives six different color tones, depending on application.



By ZEH BOUCK

AS ALTERNATIVES to suicide, the pre-war citizen rejoiced in a great variety of methods of "getting away from it all." He could go fishing, sun himself on the roof, or even snuggle up to a brass rail in cases of dire emergency.

To those who enjoyed the sense of splendid isolation that made this possible, the wartime forecasts of immediate electrification of everything in sight must have caused some anxious hours. Picture the harried postwar husband who tries to steal off for an hour of poker with the boys only to be aroused by an electronic tap on the shoulder and an urgent demand to come right home and not to forget the eggs.

Well, the good word today is that the radio waves will keep on circulating over our heads for quite a while. For better or worse, it's going to be a long time before you find yourself reaching into your watch pocket to see whether you took your portable transceiver when you left home.

But if the floodtide of imagination that broke loose when the Army announced the introduction of a five-pound "handie talkie" is in the process of settling down, it doesn't mean that nothing has been happening in the way of mobile two-way communication.

One of the most important things that has happened is that the skids have been put under some of the long-standing legal and technical restrictions on radio transmission. According to a recent announcement, the Federal Communications Commission has set aside a microwave radio band between 460 and 470 megacycles for a "Citizens' Radiocommunications Service" (CRS). The "citizens" will include ordinary nontechnical folks who have never come face to face with a grid leak. Judging by present in-

WILL YOU PHONE

Peacetime

dications, it will be easier to get a license to operate a broadcasting station than to drive a car. The comparison is particularly appropriate because the immediate prospects of mobile intercommunications are similar to those of an automobile operating on just a few miles of road.

It is only natural that both the handie talkie and the walkie talkie—instruments which proved so useful to our fighting men—should have been prominently proposed for postwar and civilian uses. The possibility that large surpluses of these two-way radios would be made available at low prices contributed materially to the idea of a walkie-talkie age, notwithstanding the fact that the Signal Corps apparatus was designed to function at frequencies far removed from those tentatively assigned to the CRS, and the probability that alert manufacturers will produce equipment specifically designed for this service. It may be that many of the talkies will be converted for civilian use, for, discounting frequency differences, it has already demonstrated some of its potentialities in pickups and interrogations from auditoriums, in mobile reporting of sports and other events, and with the War Emergency Radio Service.

In any event, the handie talkie and walkie talkie as they exist today are worth looking into—particularly in the light of the few things we know about transmission in the neighborhood of 460 to 470 megacycles.

Talkies are the direct outgrowth of the ultrahigh-frequency transceivers and portable transmitter-receivers used by amateur radio operators for many years prior to Pearl Harbor. The handie talkie was designed by Donald Mitchell, Chief Engineer of the Galvin Mfg. Corp., peacetime makers of Motorola radios. Handie talkies (SCR-536) and walkie talkies (SCR-300) are entirely different instruments. The former is a glorified French phone with a collapsible antenna projecting from the receiver or listening end. Mouthpiece and receiver are integral with the body or case. The transmitter of the SCR-536 is amplitude modulated and crystal controlled on selected frequencies between 3.9 and 5.5 megacycles; the receiver is a five-tube superheterodyne. To reduce operational complications to a fool-proof minimum, volume, tuning, and tone controls are omitted; frequency is shifted by changing the crystal, and the on-off

Jobs for the Handie Talkie

switch is operated automatically by placing the antenna in position. A simple switching arrangement, over which the fingers close naturally in holding the instrument, shifts it from receiving to transmitting positions. Approximately five pounds of concentrated radio, with a range of from 1.5 to 5 miles on $\frac{3}{4}$ -watt output, are housed in a die-cast container 3" by 3" by 12".

In Army operation, where soldiers must be constantly prepared for reception, the set is on for comparatively long stretches. Under these conditions, battery life is from 8 to 15 hours, depending on the duration of active periods.

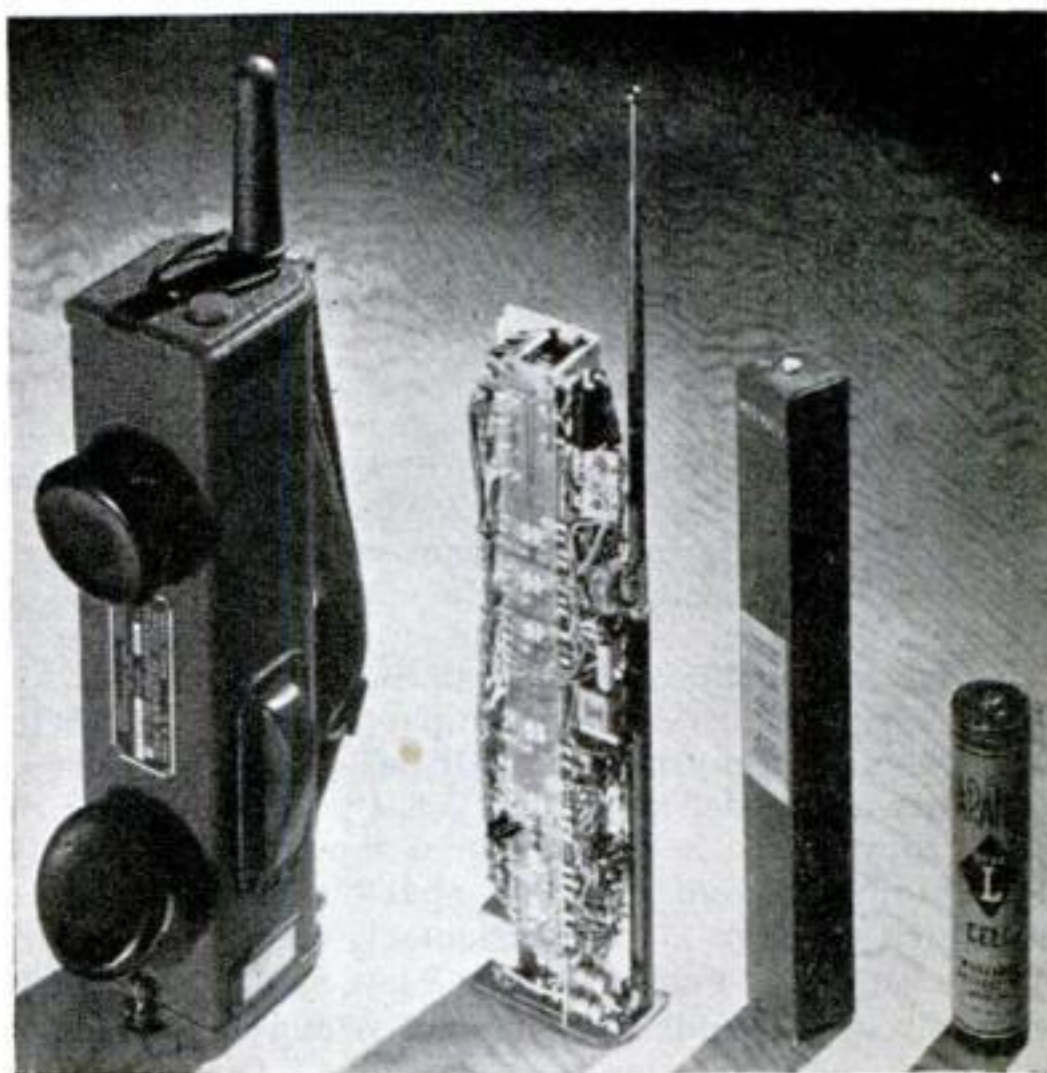
The walkie talkie differs from its little brother in that it is a frequency-modulated instrument and is tunable, without the aid of crystals, from 30 to 40 megacycles. Transmitter, superheterodyne receiver, batteries, and all, the walkie talkie weighs about 35 pounds. Built in haversack style, the SCR-300 is carried on the back; it has an output of 115 milliwatts (about one seventh that of the handie talkie) and a normal range of approximately 5 miles. Over water the walkie talkie has been used reliably at distances of 24 miles. While this is good performance, it doesn't tell us very much about what may be expected 400 megacycles higher up.

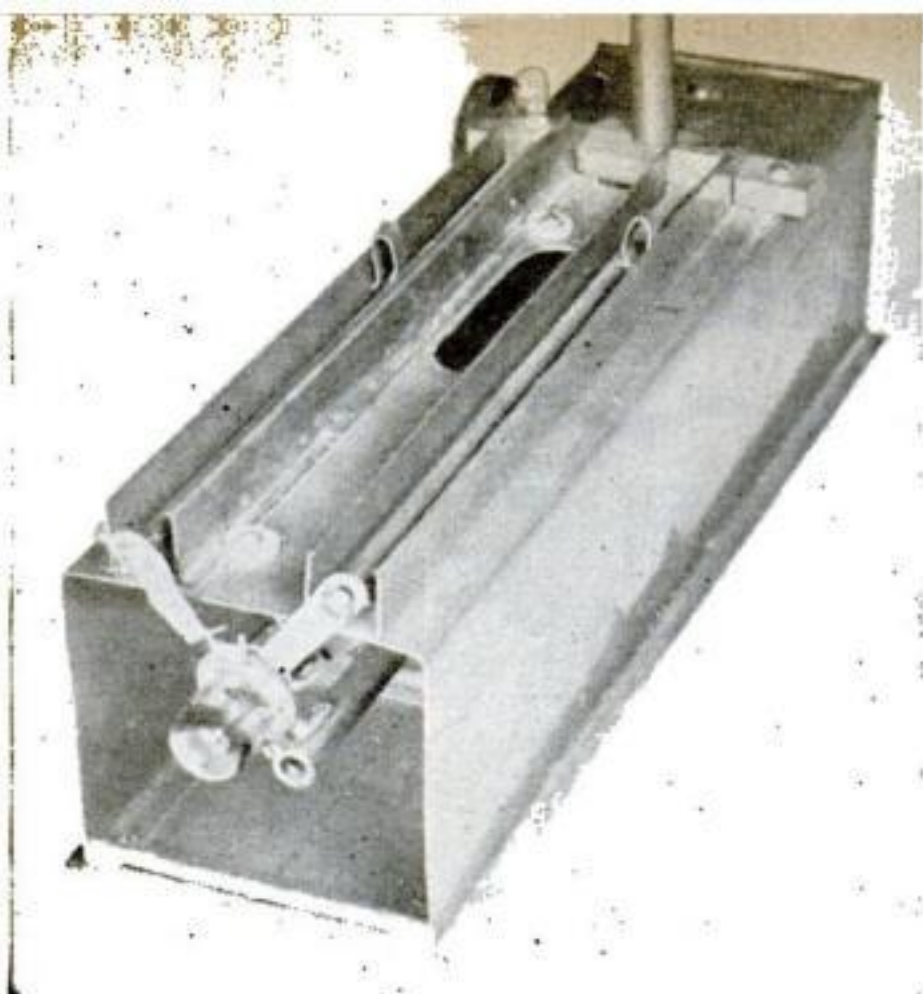
Obviously, neither of the SCR models is applicable to CRS operation without considerable modification. The 460 to 470 megacycle band is in the lower portion of the partially explored microwave region which extends from one meter to one centimeter in wavelength, or from 300 to 30,000 megacycles in frequency. Techniques vary throughout this vast region from the familiar condensers, coils, and wires on the low-frequency end to resonant cavities and wave guides (metal boxes and pipes) as we proceed higher up. The conventional fishpole type



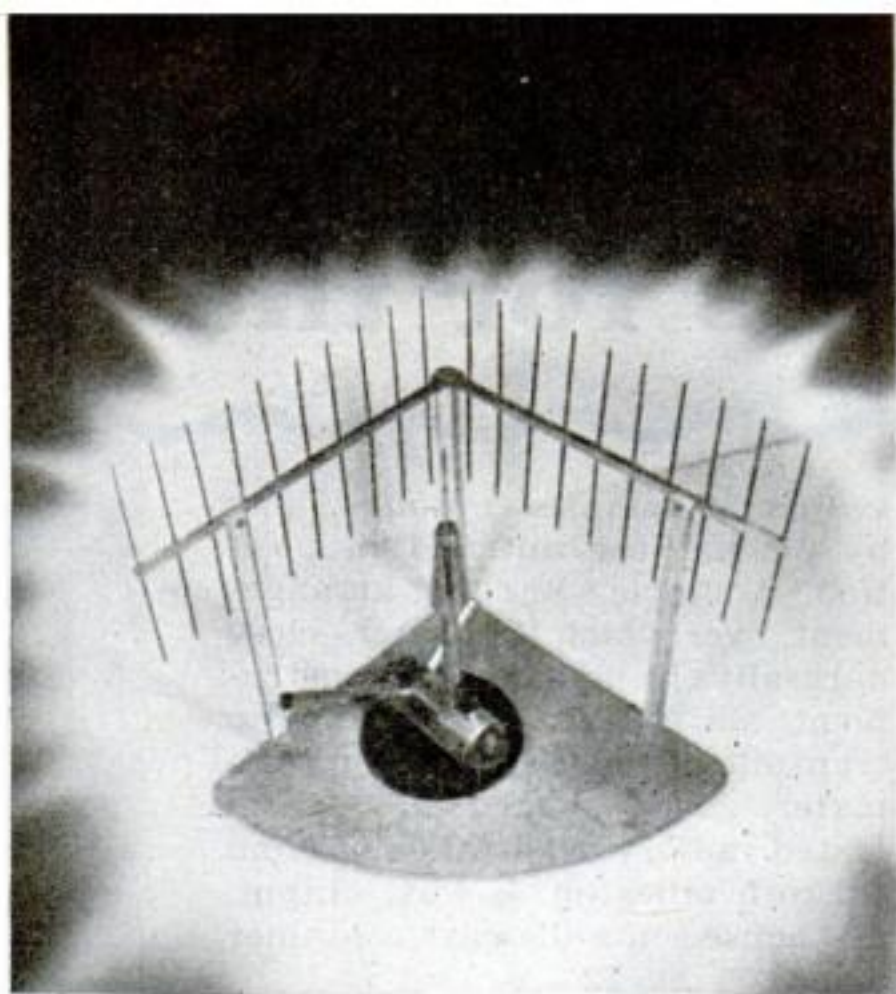
What's wrong with this picture? If you were Dr. Jones, would you rather get out of your car to communicate with your office or just tune in as you drive along? Converted handie talkies will have to compete with transceivers built to fit your auto.

Below is the Army handie talkie with and without its clothes.





Range will be an important consideration in a microwave transmitter. This one was heard 60 miles away.



Your microwave transmitter may require a reflector antenna to send the signal where you want it to go.

of antenna gives way to a parabolic reflector or perhaps something resembling a tin funnel.

But assuming that the frequency band ultimately fixed for civilian intercommunication is not too extreme, there is no reason why the SCR-536 and 300 cannot be rebuilt for such uses at a cost that would make the war surplus models worth buying. Conversion will definitely be a job for the expert, and it is quite possible that a Government O.K. on the finished product—indicating its stability within the assigned frequency band—will be required.

Handie talkies will undergo the more severe metamorphosis. Most of the receiver and all of the transmitter will have to be scrapped, even including insulating materials whose characteristics are not suitable for microwave operation. Nevertheless, the midget case should still be able to encompass the reconstructed set; similar sizes have been achieved by amateurs on the 112 and 224-megacycle bands. One such transceiver is pictured at the upper right of the following page.

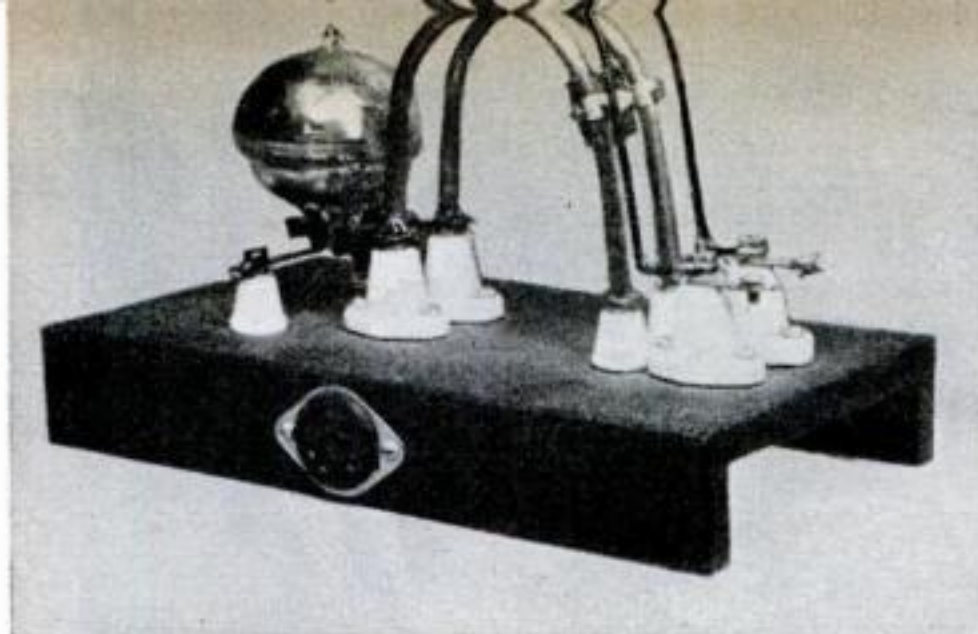
Because it allows more room in which to work, and because more of its material can be salvaged for microwave transmission, the walkie talkie presents less of a conversion problem. Amateurs before and during the war developed similar models at higher operating frequencies which compare favorably with the Army models. All basic civilian needs are satisfied by the WERS (War Emergency Radio Service) model shown at the bottom of page 175. The pack model illustrated on page 176 is particularly clean-cut and efficient. Fastened to the left shoulder strap is a small loudspeaker which is also used as a magnetic microphone. On

the wearer's belt a large pushbutton cuts in the transmitter; it can be operated by either hand or forearm, or by leaning against some object, should necessity warrant.

SCR models are strictly military designs, engineered to standards and qualifications that will not obtain in civilian use. While converted Army talkies, therefore, may represent an economical introduction to a Citizens' Radiocommunication Service, theirs will be the first word rather than the last. They have features unessential to civilian purposes, such as extreme ruggedness and auxiliary and interchangeable equipment. Walkie talkies, for example, have extra gooseneck antennas that make operation possible from a prone position. For nonwar users this represents a somewhat too luxurious refinement. Factors of no interest to the Signal Corps, on the other hand, will become very important to the man in the street when he finds himself toting a radio station about.

By name and nature the walkie talkie is perambulatory—a portable, battery-operated, transmitting and receiving radio. Exercising its corporate imagination, the FCC foresees a use for such equipment despite the fact that it has no consistent place in the home, office, car, boat, or plane, where a more economical and reliable power source is available. One would not ordinarily use a portable radio in a living room where a house-current console is in working condition.

Manufacturers are not likely to overlook this matter of power supply when they go into production. It is reasonable to expect that they will produce house-current models and storage-battery designs with vibrator high-voltage power supplies for all but



Doorknob and pullstrap? No. The photo above shows how radio designs may change as frequency goes up. The bulbous object is the transmitting tube; the arched copper tubing constitutes the tuned circuit.

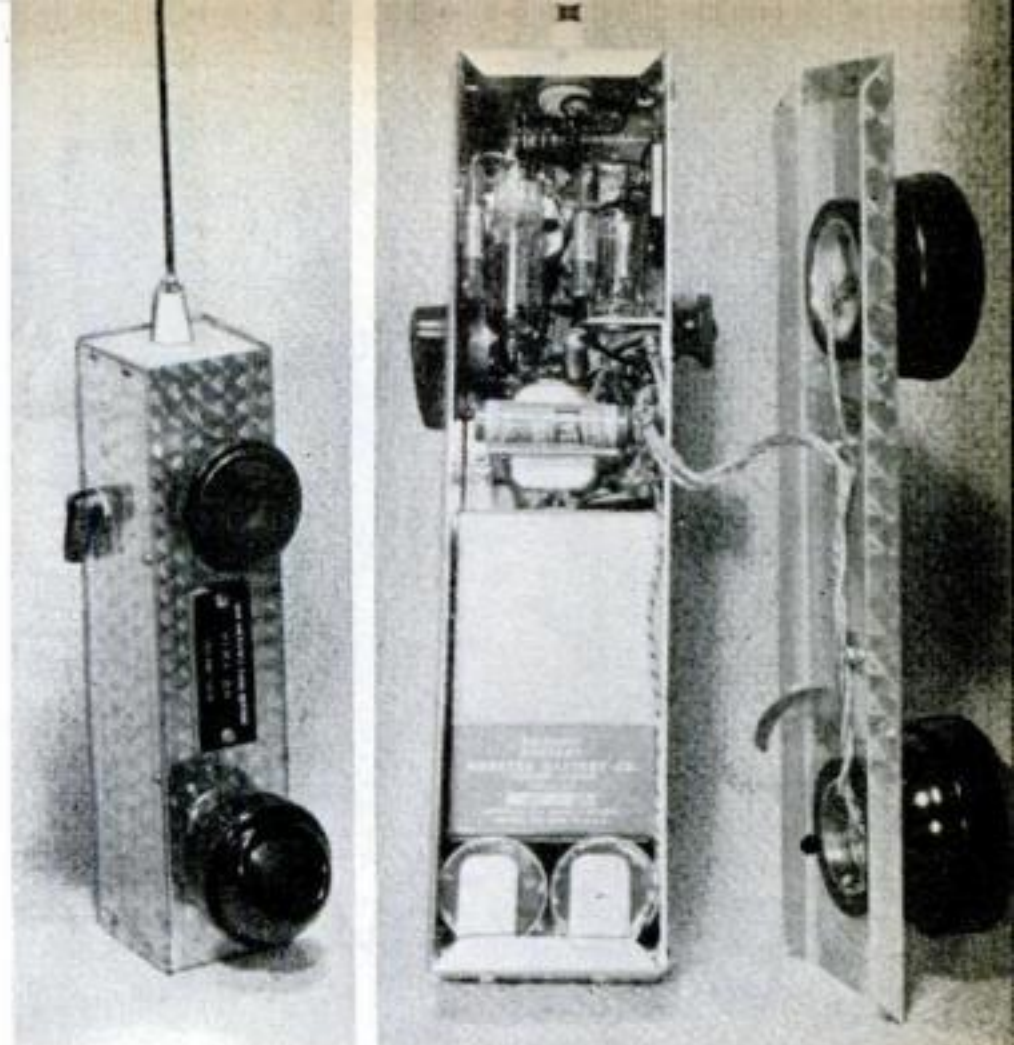
Smaller and lighter than its prototype, the home-made, 112-megacycle handie talkie, right, proves that higher-frequency transceivers can be compact.

strictly portable operation. Combination circuits that will work on either power source are also to be expected. In your car a transmitter-receiver might well be combined with the regular broadcast set.

Since considerations of battery life won't affect the power-operated models, it will be possible to include some kind of signaling system. The receiver may be left on continuously or when a call is expected. A signal broadcast on the frequency to which the receiver is tuned will actuate a relay closing a bell-ring circuit. The transmitter can be turned off during these waiting periods if separate switches are used.

Another advantage of nonportable transceivers is that they will be able to use two aeri-als and tuned circuits instead of the talkies' one. This will eliminate the need for switching from transmitting to receiving and make it possible for both signals to be broadcast simultaneously. Thus, transmitter A and receiver B would be tuned to one frequency while transmitter B and receiver A are tuned to a second frequency, and you will speak and listen exactly as you do over the regular telephone. Simultaneous transmitting and receiving units built along these lines are used in spot news broadcasts, enabling the commentator to monitor and receive instructions and cues all at one time whether he is talking or not.

Telephone companies plan to distribute small auxiliary units for use with approved equipment that will transfer the radio signal to the telephone line or take sounds off the wire and broadcast them into space. This would couple any outside transmitter-receiver with the world-wide telephone network. If a truck dispatcher, for example, wanted to communicate with a vehicle on



the road, he would telephone to a relay station within a 15-mile radius of the spot where he thinks the truck should be. The telephone relay station would then feed the signal through a transmitter tuned to the frequency of the truck's receiver. In a matter of seconds the telephone-radio combination could bring the dispatcher and the

WERS amateurs have built walkie talkies that meet basic civilian requirements in all but frequency.





Various types of walkie talkies similar to the one shown at the left were used in civilian defense. Two separate sets enable the news-broadcasting team, right, to transmit and receive messages simultaneously.

driver into voice communication over a distance of hundreds or even thousands of miles.

Such service as this, however, would necessarily require a considerable investment on the part of the subscriber and, in any event, couldn't be realized for some years to come. Moreover, it is a far cry from the strolling citizen and his plans of phoning home by radio.

Opinions vary but the consensus is not encouraging. Some manufacturers doubt that the price of handie or walkie talkies could be made low enough to interest farmers and physicians; they point out that one set would be of no use to anyone unless you fancy the idea of talking to yourself.

If this sad reminder makes the picture look too bleak, you may find some cheer in the prewar record. For some years before Pearl Harbor, commercially produced transmitter-receiver combinations, working as high as 112 megacycles, were selling for considerably less than \$50, complete with batteries, tubes, and microphone. This apparatus was manufactured for sale to some 60,000 licensed amateurs, but the potential market was probably no more than a third of this figure. What with the greater technical knowledge born of war and the lowered licensing requirements, it is estimated that there will be some 250,000 licensed amateurs within five years. When you take into account the fact that the only limit to this figure is industry's ability to produce good, inexpensive equipment, you will see why you can stop worrying about creating an incentive for the engineers.

The primary hitch, then, is not that of cost but of quality of operation. What can be expected in the way of performance from 460-470 megacycle transceivers is a matter more for conjecture and future demonstration than for prediction based on accumulated data. Frequency modulation rather than amplitude modulation seems to offer the greater possibilities for maximum intelligible-transmission distance with minimum power. Transmission characteristics vary rapidly with frequency as we approach the microwave region. For example, perfectly satisfactory communication has been maintained on the 112-megacycle band between a walkie talkie on a subway train and a WERS control station in a skyscraper—conditions under which some lower-frequency contacts would be impossible.

However, it is reasonably certain that signals in the 460-470-megacycle spectrum will cast definite "shadows"—that propagation will closely parallel that of light radiation. There will be no sky or reflected wave to make possible direct, long-distance communication as on the lower frequencies. Not considering minor bending and diffusion, the ultimate transmitting range is limited by the horizon. Assuming an average antenna height of 10' above ground level, operators could communicate with each other over level ground for a distance of 11 miles. Range, however, increases with elevation. Very loud signals have been received over a line-of-sight distance of 60 miles at 400 megacycles. This is close enough to the CRS band to provide an inkling of what the future may hold.

SIGNAL BOOSTER BRINGS IN WEAK STATIONS

RADIO listeners who confine themselves to local network outlets and independent stations are sometimes pleasantly surprised when a stray combination of elements brings in an unexpected broadcast from distant parts. It is only when such accidents happen that most of us realize how much first-rate entertainment never reaches our ears.

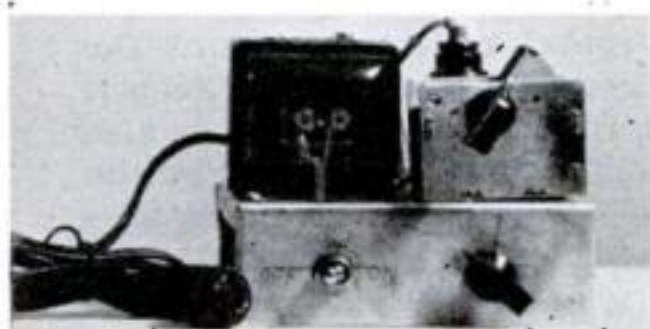
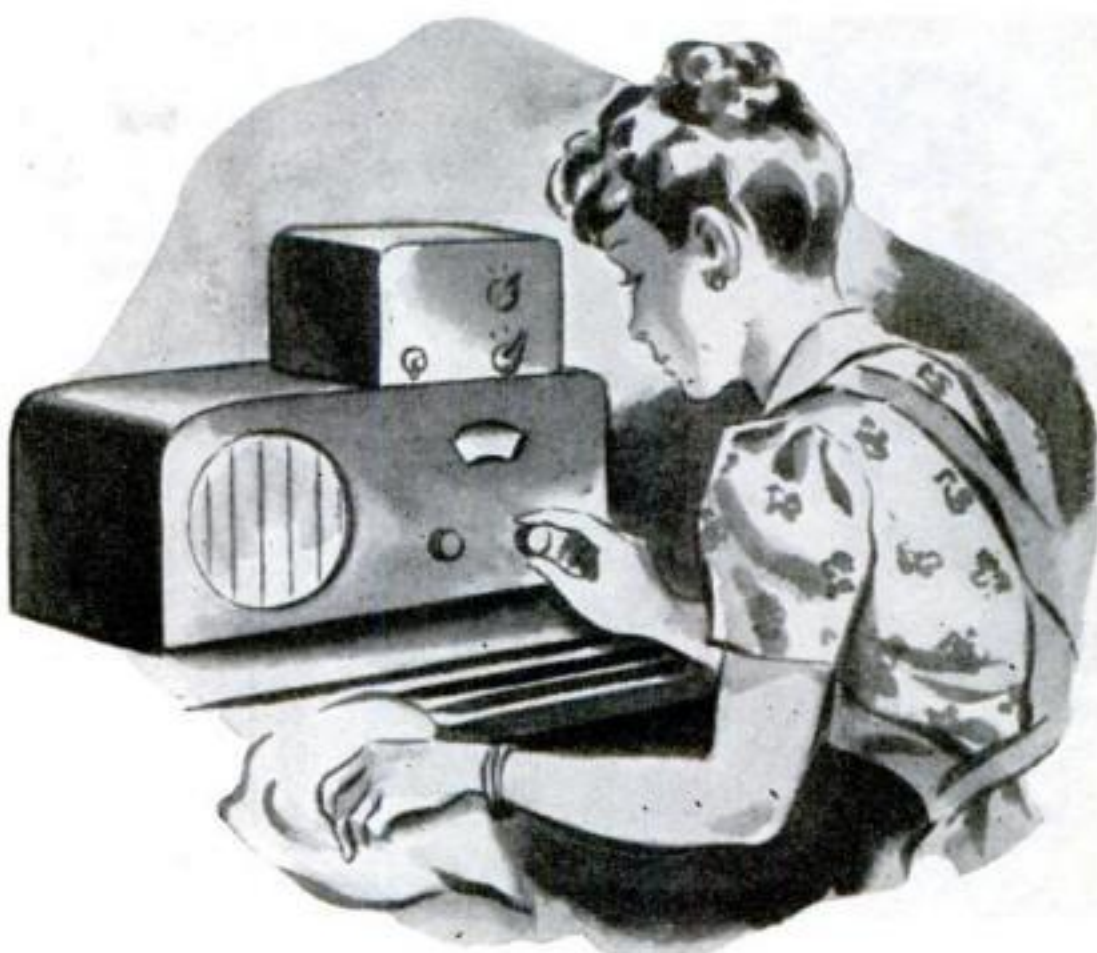
To overcome the short reaching power of most home radios, the booster shown in the photos below reaches out and drags in weak and fading signals. The regenerative circuit gives it a usable gain comparable to that of a two-stage amplifier, while the antenna circuit improves the signal-noise ratio. When no boost is needed, a flick of the change-over switch cuts the plate voltage of the amplifier tube so that no interfering harmonics are radiated.

Feedback is obtained by adding one turn of 22-gauge silk-covered wire around the ground end of a regular broadcast-band antenna coil in the same direction as the coil winding. Tap off the antenna lead one quarter of the way from the same end. Ground the shield of the output lead to the chassis of both the booster and the receiver.

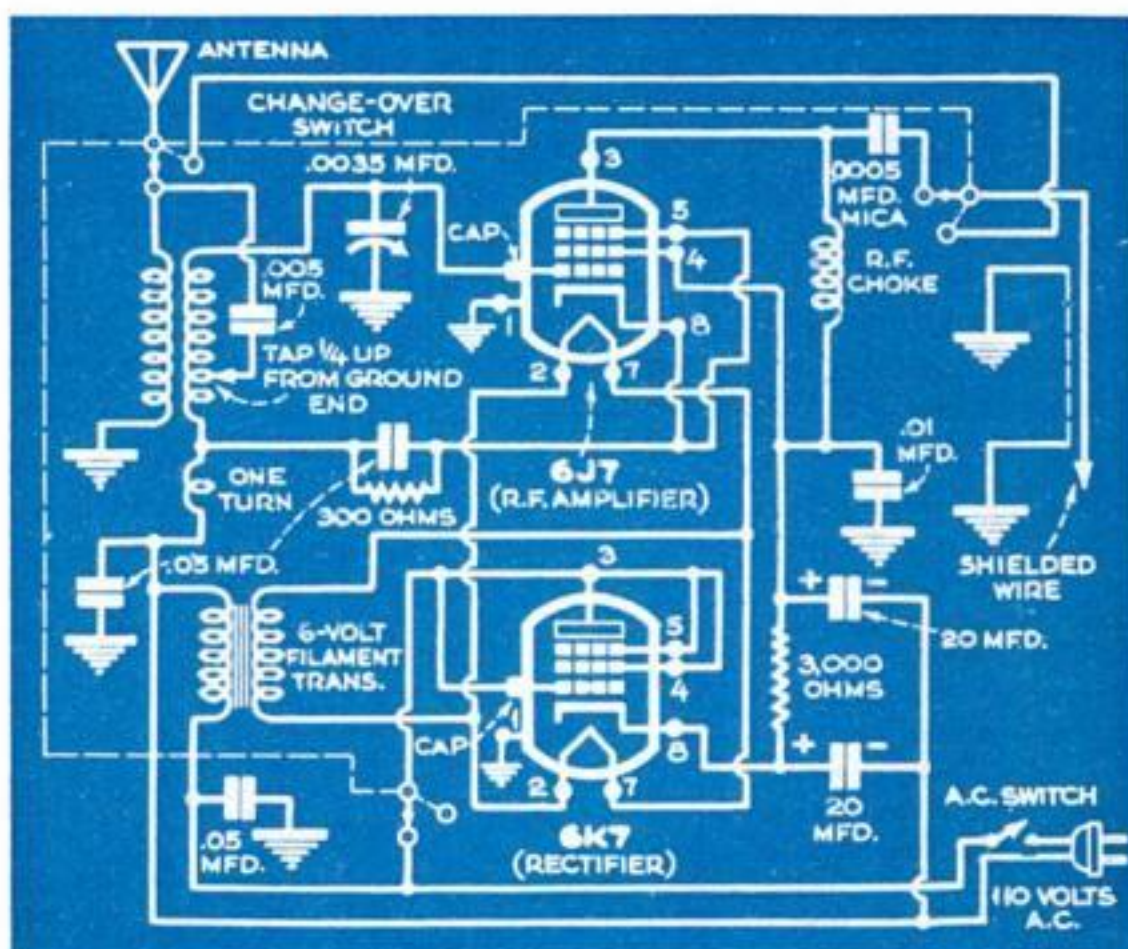
A 6J7 tube is used as the R.F. amplifier by design, but the 6K7 found its way into the rectifier circuit only because a discarded one happened to be handy. Many otherwise

unservicable tubes will operate as rectifiers when plate and grids are tied together.

If the filament switch is turned on while the change-over switch is off, the booster can be kept warmed up and ready for use. When the signal starts to fade or a weak or distant station is wanted, the booster is switched in and tuned for maximum signal. If a hum is heard when the booster is used with an A.C.-D.C. radio, it may be necessary to reverse the plug connecting it to the 110-volt line.—GEORGE BOLTON.

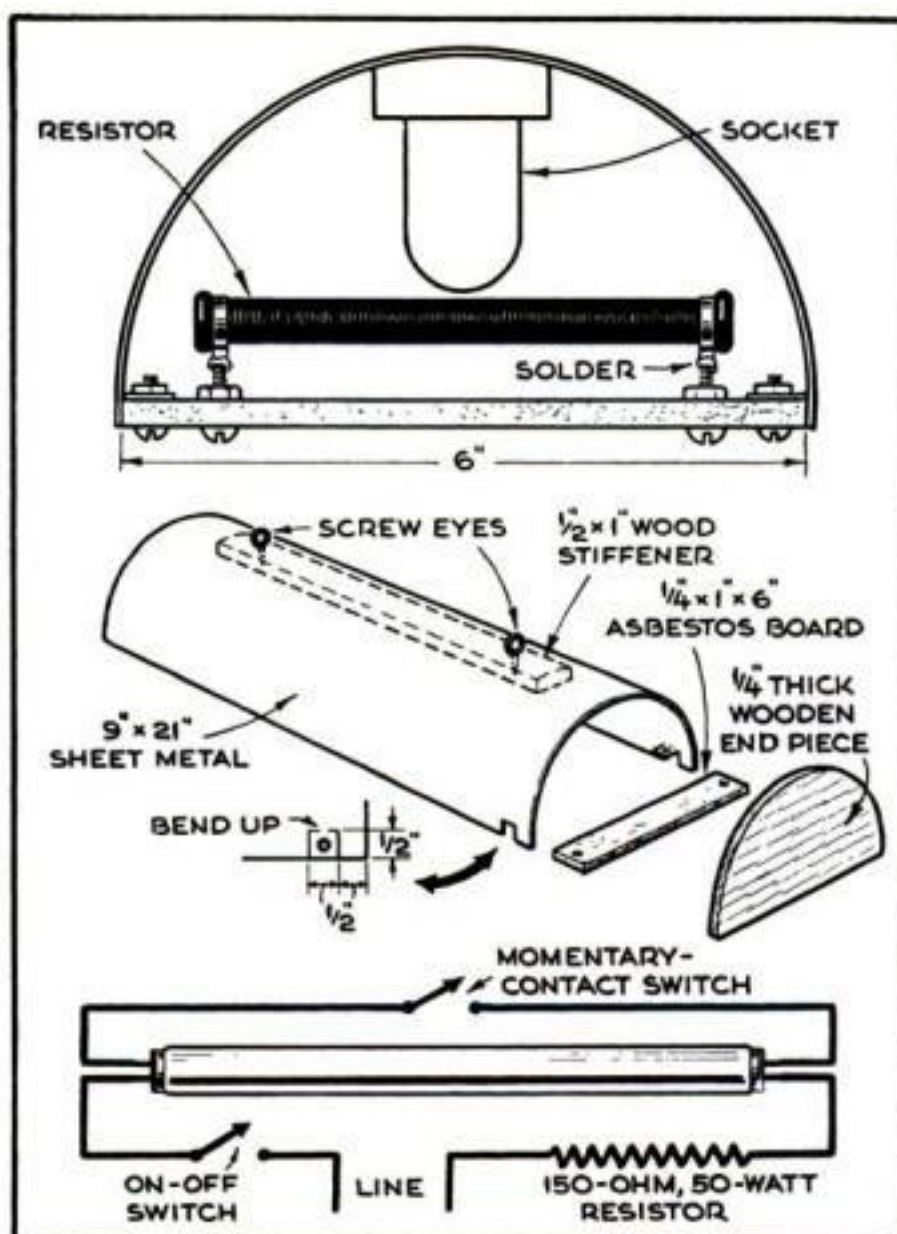


Completely assembled, the booster is compact on a chassis 2" by 5" by 5½". Standard parts are used.





Built at home, this 15-watt fluorescent lamp uses a 150-ohm, 50-watt fixed resistor as a substitute for an inductive ballast. The resistor is ventilated.



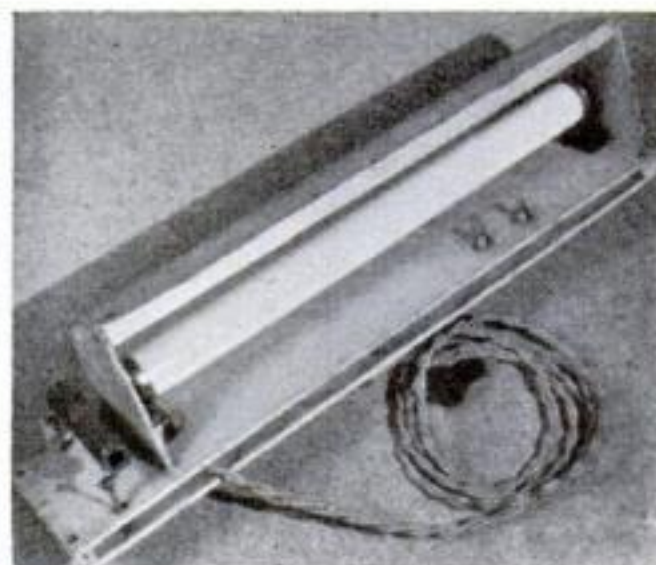
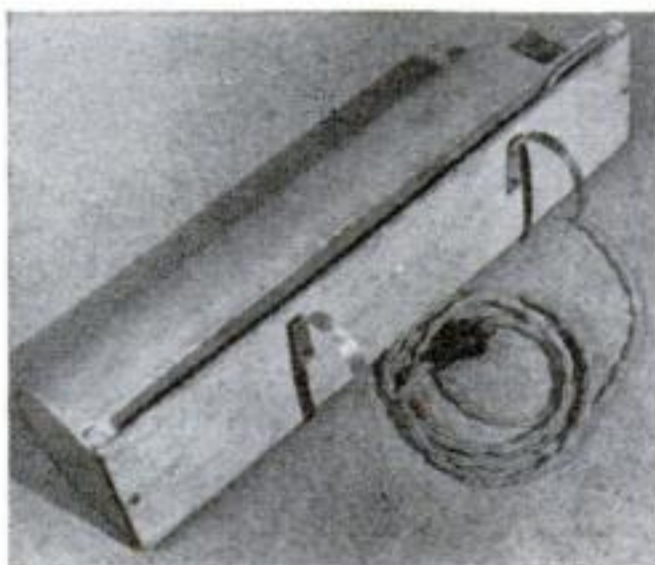
Fluorescent Lamps Without Ballasts

PERHAPS you've wanted to make a fluorescent light but have been stopped by the difficulty of obtaining a regular inductive ballast. Actually, ballasts aren't needed for fluorescents of 15 watts or smaller; in their place, you can use ordinary wire-wound resistors of the proper value and wattage. The current draw will be slightly greater; but, since such lamps are economical anyway, the extra cost is negligible.

For a 15-watt light (the common size measuring 18" between terminals), you should use a 150-ohm wire-wound resistor, capable of dissipating 50 watts. Mount it in a ventilated position, for considerable heat will be generated, and do not use one of less than 50 watts. Wire the resistor in the circuit exactly as you would an ordinary ballast, in series with the line.

Specifications for an overhead light, particularly useful in a workshop, are given above. The resistor is mounted on an asbestos board placed across the reflector. If you prefer a wall lamp for the kitchen, bath, or bedroom, cut a piece 5½" by 22" from plywood or pressed composition board. Coat one side with aluminum or white paint and attach two regular fluorescent-tube sockets. Place the resistor across one end so it will be outside the metal reflector. Mount the resistor with screws long enough to keep it about 1½" from the base. These screws also will serve as connections. Two pushbutton switches are needed—one of the momentary-contact type and the other a regular 115-volt off-on switch (a radio toggle switch will do). Run the wiring on the back and protect it with a second board.—TRACY DIERS.

Metal hooks on the back fit this fixture for use over a bed. Notice that an extra board was added to protect the wires on the back of the base. In the photo at the extreme right, a fixed resistor has been mounted on the base outside the end of the reflector. The latter is formed of light metal.



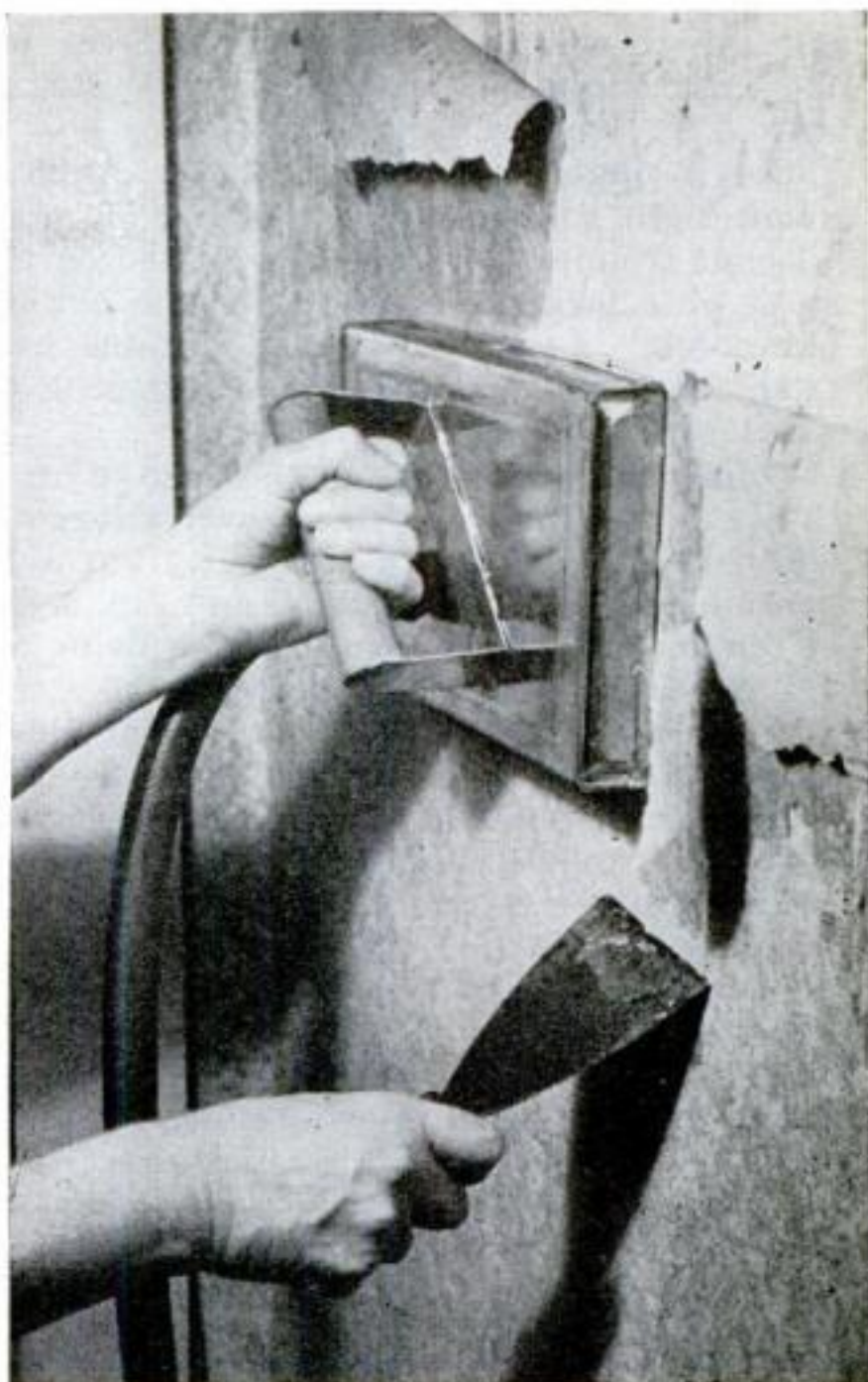
GAS-STOVE STEAMER PEELS WALLPAPER IN A JIFFY

By Vernon B. Case

STEAMING has long been considered the quickest method of loosening wallpaper—as you may have noticed in a papered bathroom after having let a hot shower run for a long time. The trick is to get the steam where it will do the job you want done most effectively.

An efficient steamer can be made from a 2-gal. kerosene or gasoline can having a spout with a screw-on cap, a length of garden hose, and a 1-gal. rectangular can. The larger can serves as a boiler. One of 2-gal. capacity will produce steam for two or three hours on one filling, but a larger one may be used. Make certain that the can contains no residual fumes. An afternoon in the sun, with all ports open, followed by thorough washing with soap and water, ought to clean it. If possible, use a new can that has never held an inflammable liquid and therefore involves no explosion hazard.

In the center of the screw-on spout cap cut a hole about two thirds of the cap diameter. Then solder to the cap a metal hose coupling, a faucet strainer, or a pipe fitting that can be screwed to a hose con-

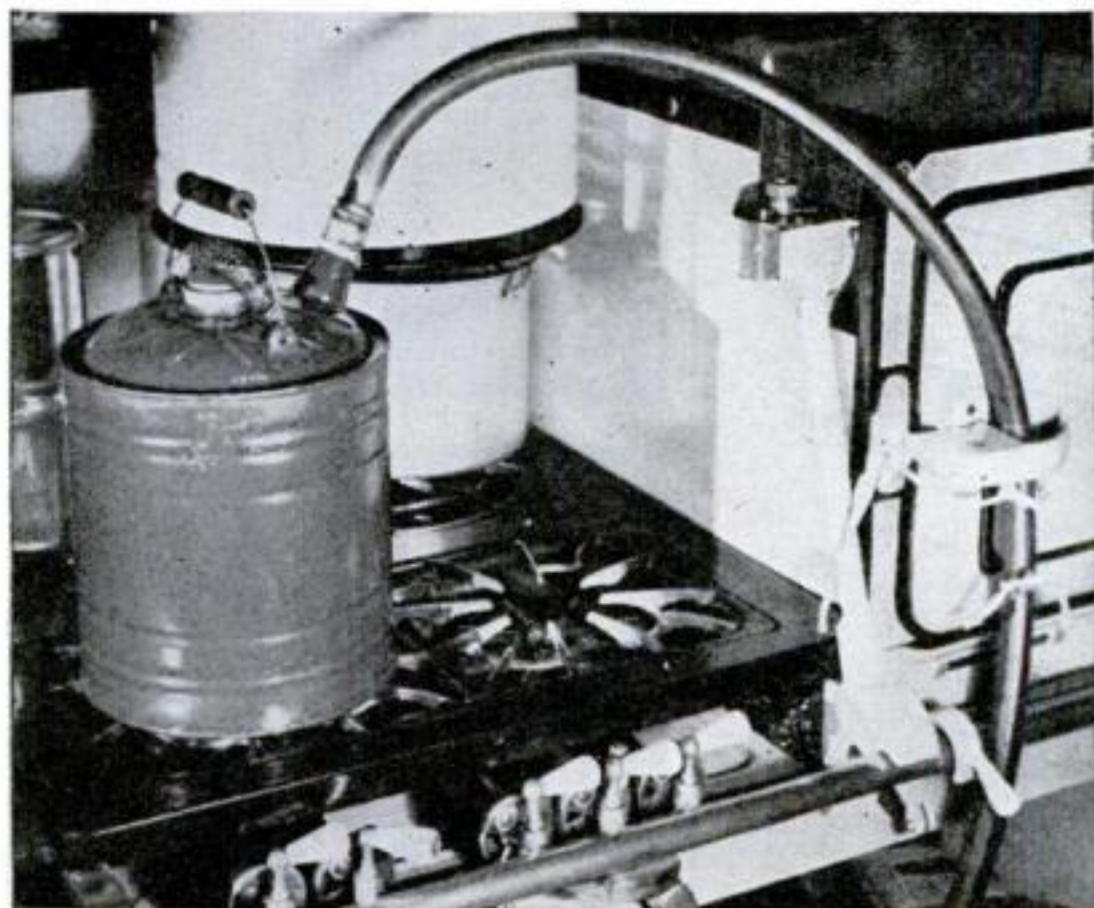


Holding the applicator against a wall steams the paper off in sections. The handle won't get hot.

nection. A strip of tin-can material wrapped around the joint may make soldering easier. In use the garden hose is screwed to the spout connection, as shown in Fig. 1, with a rubber or cork washer to make a steam-tight seal.

Substitute for the filler cap a safety valve made of a disk of inner-tube rubber or some similar material about $\frac{1}{2}$ " larger in diameter than the opening, a similar disk of stiff metal, fiber, or wood, and a not-too-strong coil spring that will stretch between the handle eyelets and across the opening. Place the rubber disk over the opening, lay the second disk on it, and adjust the spring, as in Fig. 2, so it will hold both disks in position with moderate pressure. You can determine by blowing into the spout whether or not the spring is too tight. Moder-

For a room that can be reached from the kitchen, the boiler may be heated on the range. Lashing will prevent accidental overturning of the boiler.



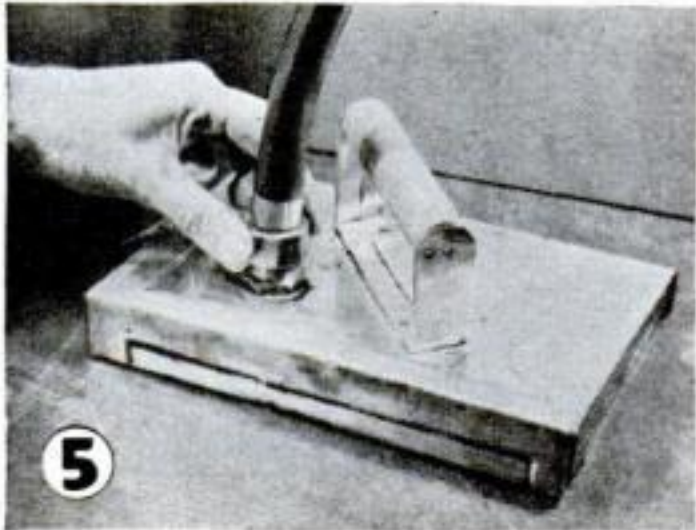
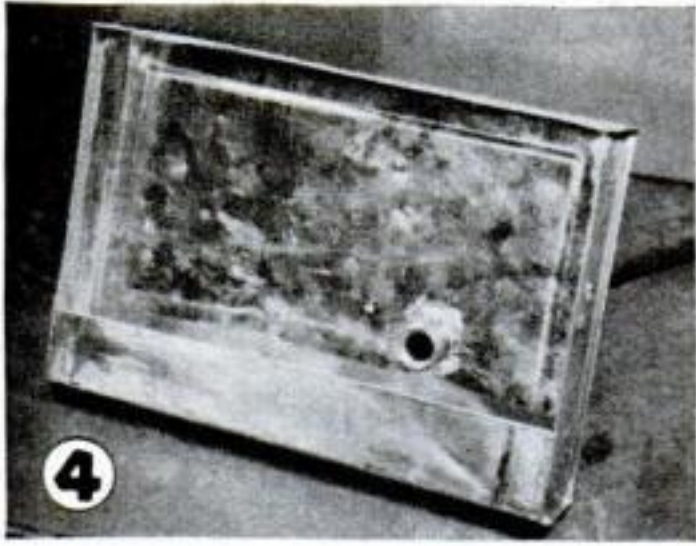
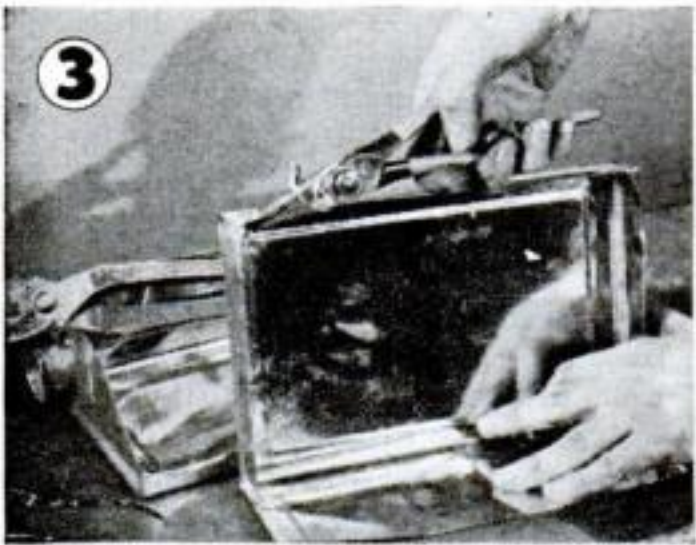
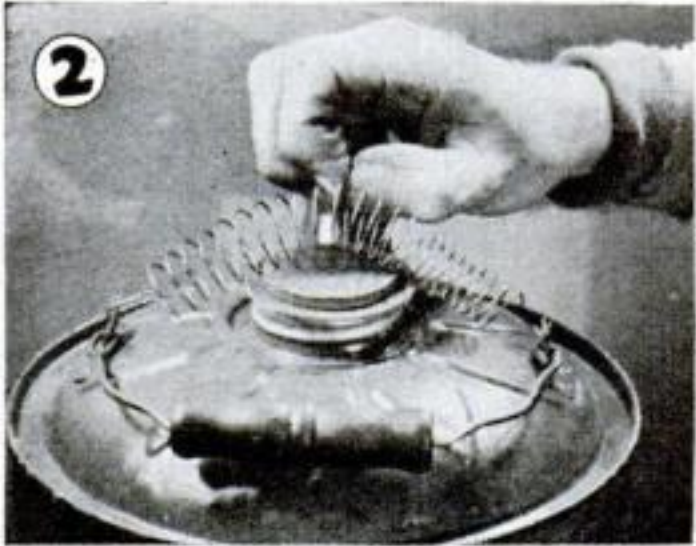
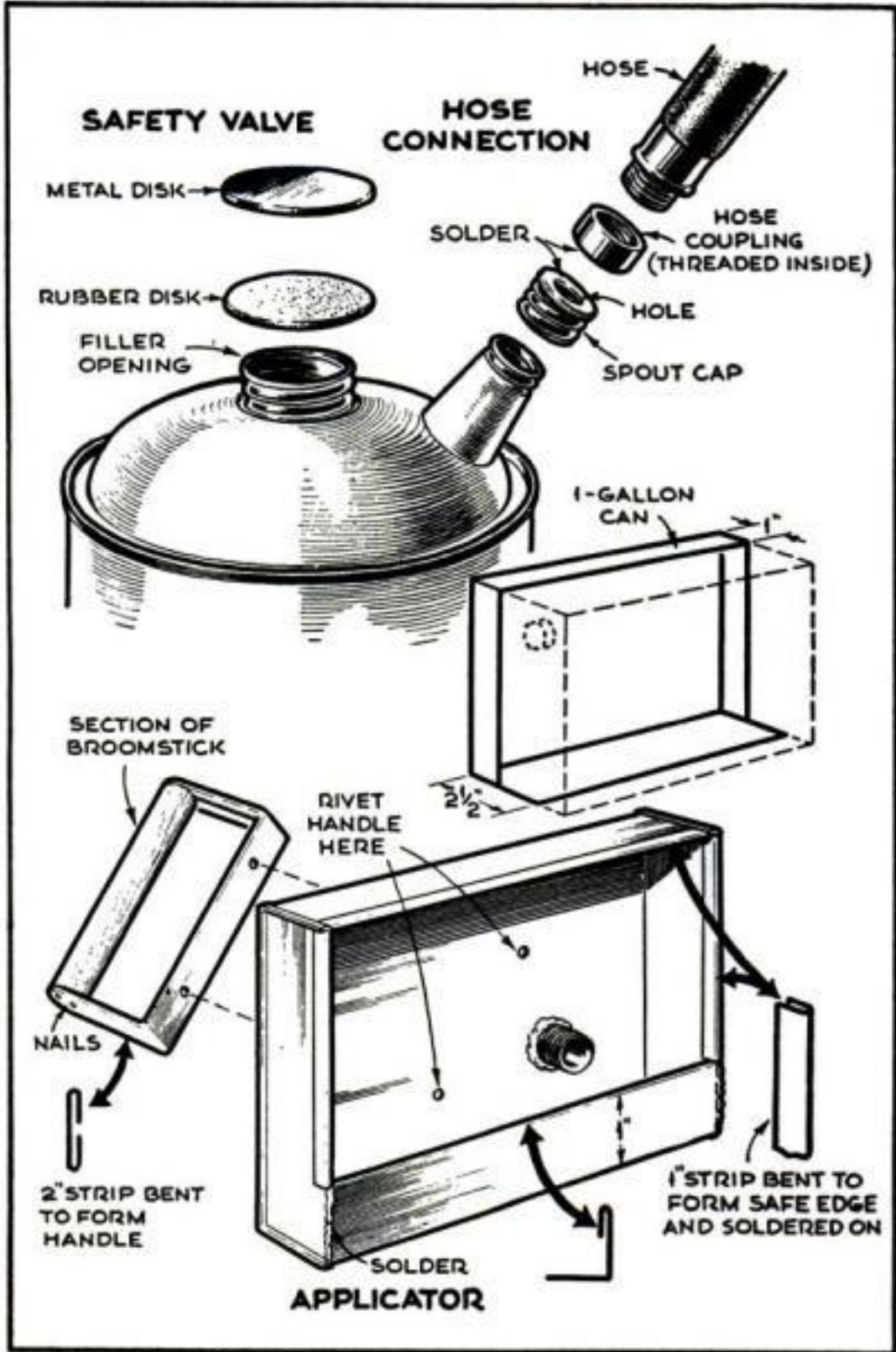
ate pressure should raise the rubber disk and permit air to escape. The valve relieves pressure if the hose kinks or is clogged with steam condensation.

Use a pliable, lightweight hose. A 25' length is about right for most purposes, but 50' may be used without trouble. The water is heated on the kitchen stove or a large-size gas or electric hot plate, by a blowtorch, or with any other suitable heat source. Lash the hose to some rigid object so a direct pull won't overturn the boiler.

Connect the other end of the hose to an applicator that will distribute the steam over a large surface of wallpaper. That shown was cut from a 1-gal. turpentine can, as in the drawing and Fig. 3. The pocket at the bottom, also shown in the drawing and in Fig. 4, catches water condensing from the steam.

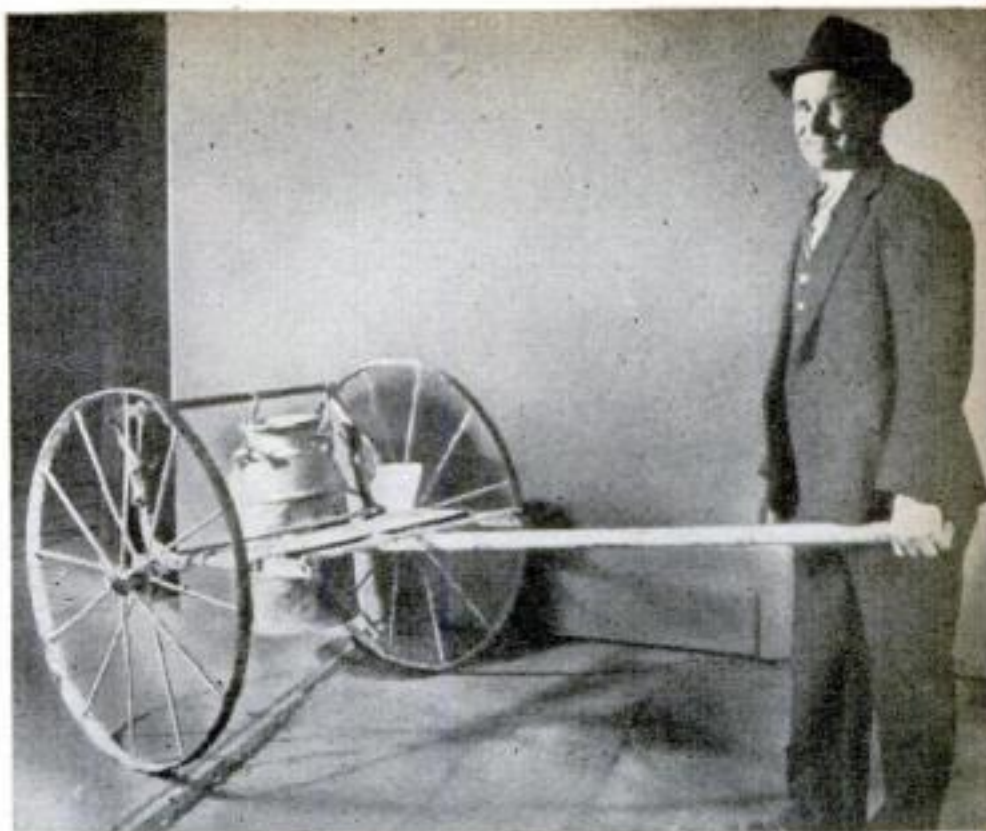
Solder a hose connection or a pipe nipple of suitable size to the back of the pan (Fig. 5) to admit steam. Baffles or channels may be arranged inside the pan, if desired, to distribute the steam more evenly.

The steamer is ready for use when steam begins to issue in volume. Hold the pan over one area until the wallpaper is soaked enough for pulling off with little assistance from a scraper. Some water will collect in the hose. When gurgling becomes pronounced and the safety valve lifts, drain the hose.



Cart Saves Backbreaking Labor in Heavy Farm Hauling Jobs

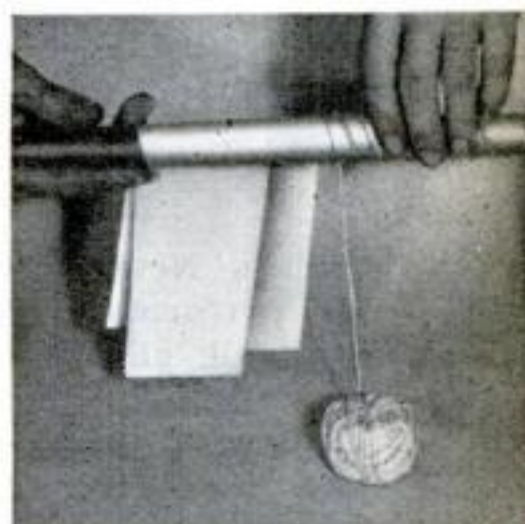
ALTHOUGH designed primarily for carrying heavy milk cans, this labor-saving cart will find many other uses around the farm. Devised by Carl Kraklow, of Rock Island County, N. Y., it has a wooden platform bolted across a metal frame between the wheels. A crossbar on the side opposite the cart tongue is equipped with hooks to which milk cans are attached. Downward pressure on the tongue raises the cans off the ground. This bar also keeps a large object, such as a bale of hay, from falling off when it is carried on the wooden platform.



Calcium Chloride and Pipe Wrappings Prevent Damp Cellars

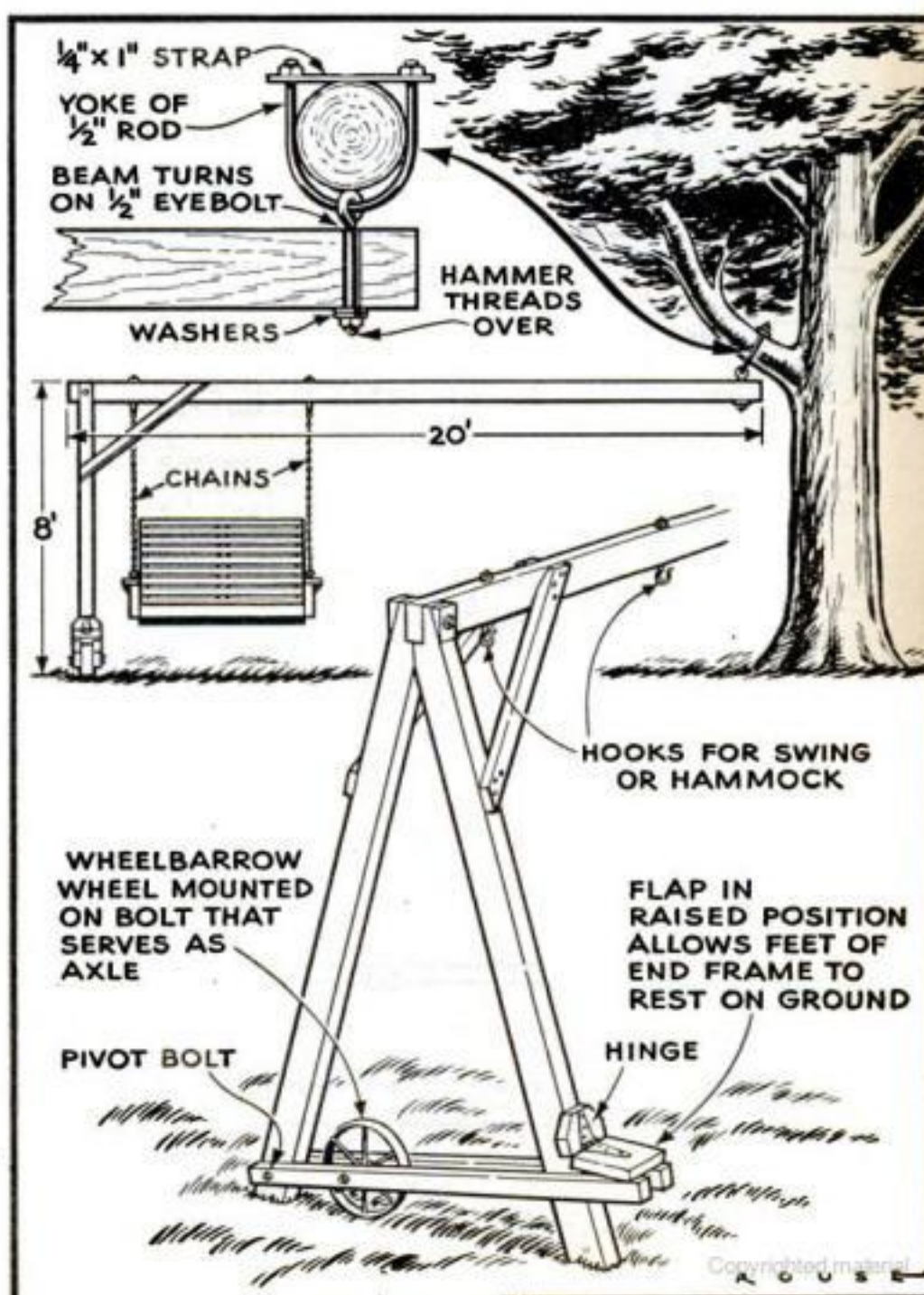


WHEN using calcium chloride to correct the dampness that recurs in many basements during the late summer, place it in a heap atop a piece of window screening stretched across an enameled tray. After the crystals of this salt have disappeared, pour off the liquid that has collected in the pan and reload the screen. Several layers of newspaper tied around water pipes will prevent the condensation and dripping that also occurs at this time.—I. G.



Swing Supported on Movable Frame Remains in Shade All Day

SHIFTED as the sun moves, this swing will remain in the shade throughout the day. One end of the heavy beam from which the swing is suspended pivots on an eyebolt attached by a metal yoke and strap to a tree limb. The other rolls from position to position on a supporting framework in which a wheelbarrow wheel is mounted between two adjustable two-by-fours. When the swing is to be moved, a hinged flap depresses the free ends of the two-by-fours, thereby placing most of the weight on the wheel. After the swing is in its new position, the flap is raised, allowing the feet of the end frame to come to rest solidly on the ground. If attached to a strong limb well out from a tree, the swing will describe the greater part of a full circle.—JACK H. REED.



SIX HIGH-SCHOOL BOYS EXPLORE MYSTERIES OF SCIENCE

Photographs by WILLIAM W. MORRIS

Drawings by STEWART ROUSE



Edward M. Kosower Produces Volcano from Chemicals

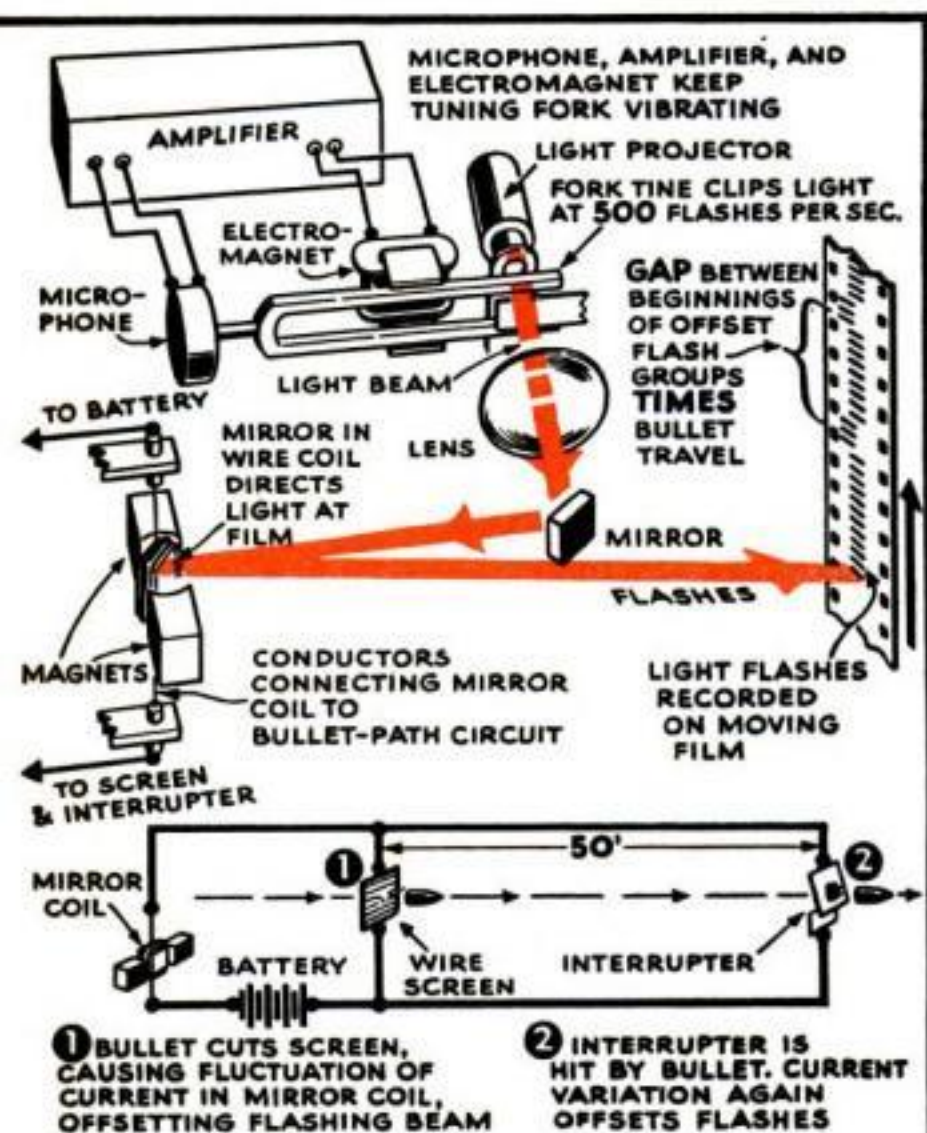
THIS New York City high school boy performs a spectacular trick with a small pile of ammonium bichromate. When ignited, the chemical oxidizes with liberation of light and heat, resulting in a volcano-like effect.

FORTY brilliant young Americans, 29 boys and 11 girls, arrived in Washington last spring with a bewildering array of scientific apparatus. All were finalists in the 1945 talent search conducted in high schools by the Science Clubs of America. With calm assurance, they exhibited their scientific hobbies in competition for college scholarships totaling \$11,000 provided by the Westinghouse Electric & Manufacturing Co. All displayed exceptional knowledge of their chosen subjects. Here are six of their most noteworthy achievements.

Edward Walker Measures the Speed of a Bullet with an Oscillograph

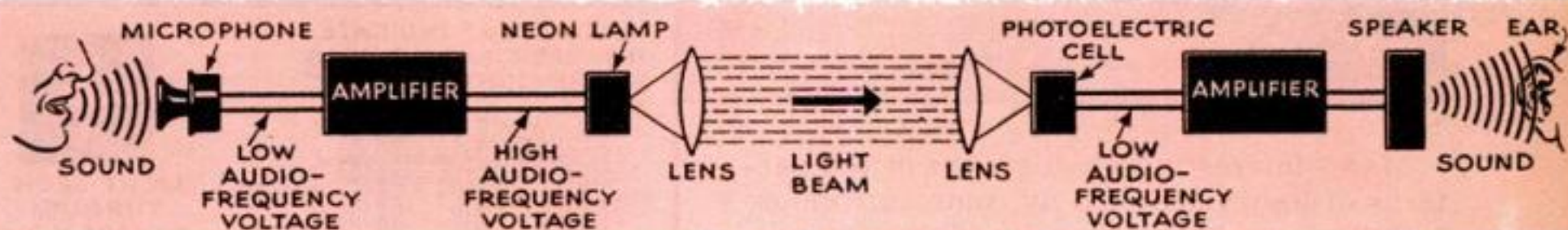
USING an oscillograph, Edward Walker, of Detroit, determines how fast a bullet travels. A tuning fork with a frequency of 500 cycles per second interrupts a beam of light, leaving a mark on a moving film for each

vibration. Therefore, the distance between two marks represents .002 of a second. As a bullet passes through a screen and an interrupter 50' apart, the light beam is offset twice, recording the time on the film.





Richard Henry Milburn Transmits His Voice over a Beam of Light



THERE was nothing theoretical about the exhibit set up by Richard Henry Milburn. Using a system he built at home in Newark, N. J., he demonstrated how he could send his voice over an amplitude-modulated light beam, the words emerging from a loud-speaker when he spoke into a telephone. His system, similar to that used in recording sound on film for motion pictures, is out-

lined in the drawing above. When sound enters a microphone, electrical impulses are created. After being amplified, these activate a neon lamp which, in turn, projects an amplitude-modulated beam of light through two lenses to a photoelectric cell about 2' away. The cell, reacting to the light beam, produces electrical impulses which pass through an amplifier and operate the speaker. ➡

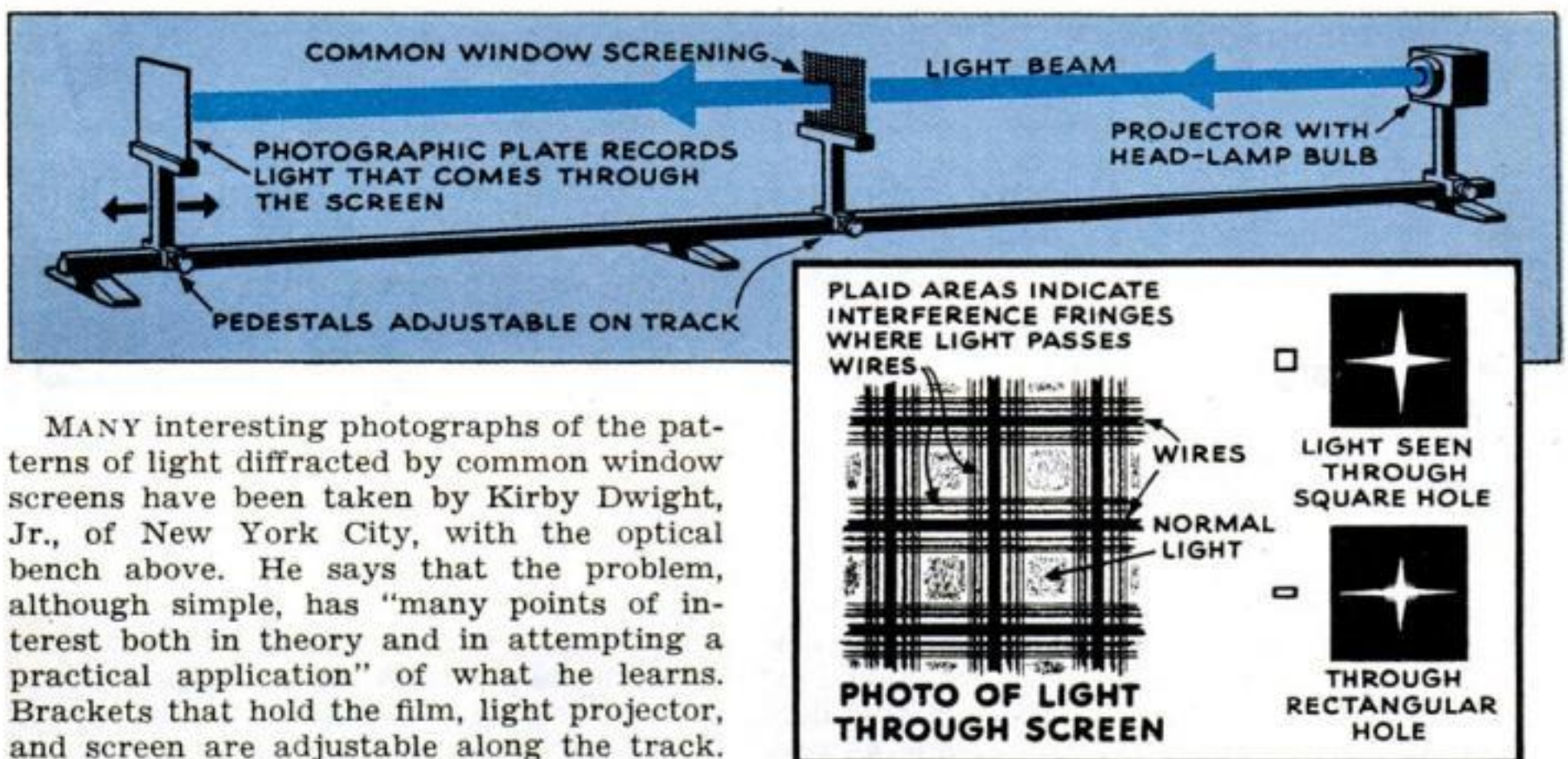
John Moore Develops Formula and Builds Model for Mathematical Problems

POLYNOMIALS no longer give John F. Moore any great amount of difficulty. The young mathematician from Scottsville, Va., developed a formula that shows how to expand any number of terms to any positive integral power. He also built a tetrahedral model for a trinomial. By using the formula, which he calls the "polynomial theorem," he can determine the value 30 times faster than by multiplying the terms. With the model, the value is found four times quicker than with the formula alone. The formula, he says, employs a "general term" applicable to all values when a problem is being solved. On the paper in front of him in the picture at the right is his proof of his theorem. He attends the High Mowing School, at Wilton, N. H.





Kirby Dwight, Jr., Studies Light Diffraction Through Window Screen



MANY interesting photographs of the patterns of light diffracted by common window screens have been taken by Kirby Dwight, Jr., of New York City, with the optical bench above. He says that the problem, although simple, has "many points of interest both in theory and in attempting a practical application" of what he learns. Brackets that hold the film, light projector, and screen are adjustable along the track.

Russell R. Ellis Builds Spectroscope for Use of His Science Club

THIS simple-prism spectroscope was made by Russell R. Ellis so that his science club in Neenah, Wis., could study the principles of spectroscopy in the refraction of light and in identifying unknowns. He removed lenses from an old pair of binoculars and a microscope, inserted them in mailing tubes, and rigged up an accurate system of adjustments on an old iron pedestal. A clamp holds the prism firmly on a pedestal between the ends of the mailing tubes. The tubes themselves are attached to adjustable arms.



CURIOSITIES FOR HOME EXPERIMENTERS

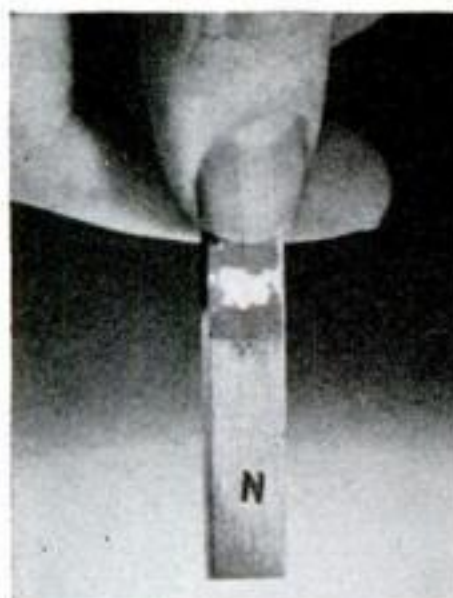


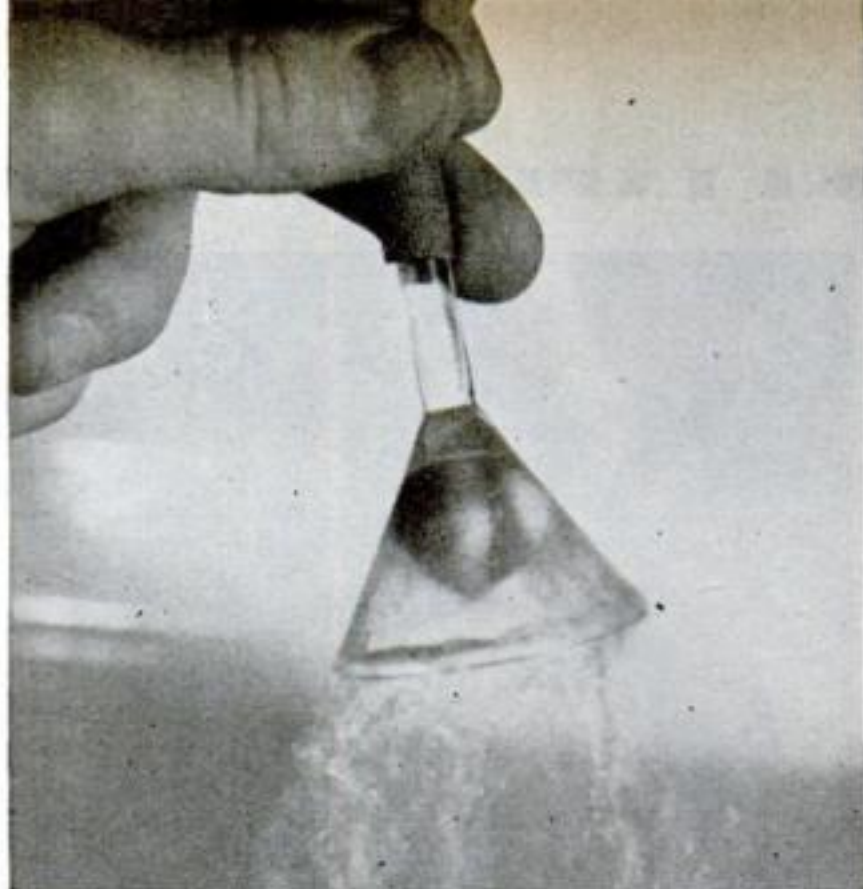
CHALLENGE YOUR FRIENDS to remove a water-covered coin from a shallow plate with their fingers—without getting them wet. They may agree that it seems impossible. But it can be done by using a crumpled piece of paper, a match, and a tumbler! The coin should be a little off center on the plate and just barely covered with water. Place the crumpled paper on the plate well away from the coin. Ignite the paper and quickly cover it with the inverted tumbler. As the burning paper removes the oxygen from the inside of the tumbler, the outside air pressure slowly forces in the water to take the place of the consumed oxygen. The coin itself, left high and dry by the receding water, is easily removed from the plate, and your fingers remain dry.



IF A DROP OF WATER falls on a clean plate, it quickly flattens and loses its identity as a drop. But the result is wholly different if the bottom of the plate is given a thin coating of lycopodium powder or zinc stearate dusting powder. The drop remains a drop, rolling over the surface of the powder and leaving a clear trail behind it. The reason? On the clean plate, the attraction between the water and the plate is greater than the attraction of the water molecules for each other. Consequently, the drop is pulled out of shape. In the case of the prepared plate, water does not wet either the lycopodium or zinc stearate dusting powders, but actually is repelled by them. Hence, the drop retains its globular shape and rolls over the powder.

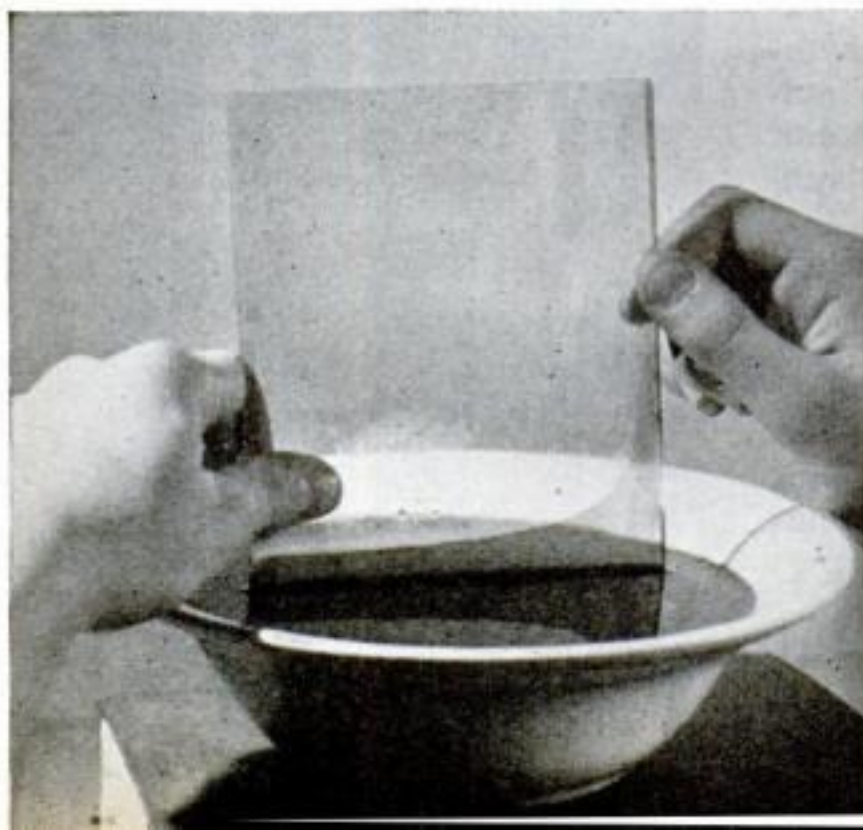
IRON LOSES its magnetic properties if chemically combined with sulphur to form iron sulphide, but when the two materials are merely physically mixed there is no change. An ordinary bar or horseshoe magnet is your best bet, in fact, for separating a mixed pile of iron filings and powdered sulphur. Rub the magnet around in the mixture, and the filings will cling to it, as shown at the extreme right, leaving the sulphur behind. Now chemically combine these ingredients to form iron sulphide. About two parts of sulphur to three parts of iron, by weight, works best. Mix the two substances thoroughly and place the mixture in a test tube. Heat the tube until a glow starts through the mixture; then remove it from the flame. The glow will continue until the mixture has all combined. After heating the tube strongly again to eliminate the excess sulphur, allow it and the contents to cool. Then remove the contents and place them once more under a magnet. This time you will find that no part of the combination is attracted.





MARBLE DEFIES GRAVITY. Thrust the end of a funnel into a rubber tube connected with a water faucet and turn on the water. If you then put a marble into the funnel, it will do a dance as close to the funnel spout as it can get. Increase the force of the water, and the marble clings closer. If the funnel is turned upside down, the marble also defies gravity. This is explained by the Bernoulli principle—the discovery made by a Swiss mathematician that pressure decreases as velocity increases. In this case pressure is lowered where the water picks up speed between the marble and the funnel walls, and the relatively high pressure opposite the spout pushes the marble against the walls, holding it there.

WATER CLIMBS between two glass plates if they are placed face to face and separated slightly at the lower left corner with several sheets of paper. Squeeze them together, exerting greater pressure on the right side than on the left. The harder you squeeze—until the plates actually touch—the higher the water rises. This results from capillarity—the action by which a liquid in contact with a solid rises or falls, depending on the relative attraction of the molecules of the liquid for each other and for those of the solid that it touches.

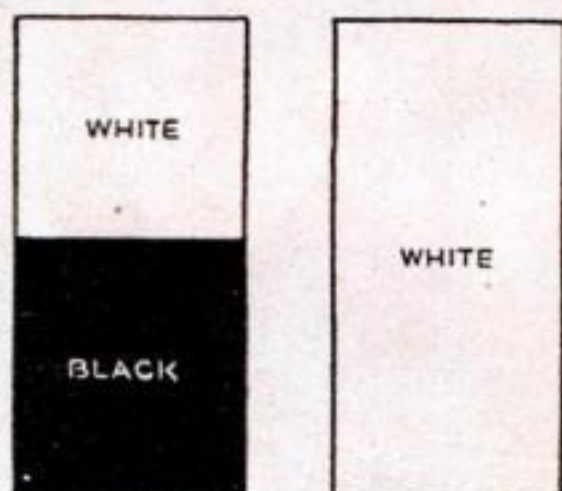


HOT-WATER SYSTEMS are excellent for heating a home, although water, strangely enough, is a poor heat conductor. As a demonstration, fill a tin-can cover nearly to the top with water and float on this a small amount of cigarette-lighter fluid. Hold the cover firmly on three fingers and light the fluid. Even after the fluid has all burned away, you will feel little, if any, heat in the bottom of the lid, although the top edge, which was near the flame, will be decidedly warmer. Any heat you may feel in the bottom results chiefly from conduction through the metal itself. In hot-water heaters, heat is transferred by convection—movement of the heated water bodily from one place to another due to temperature differences.

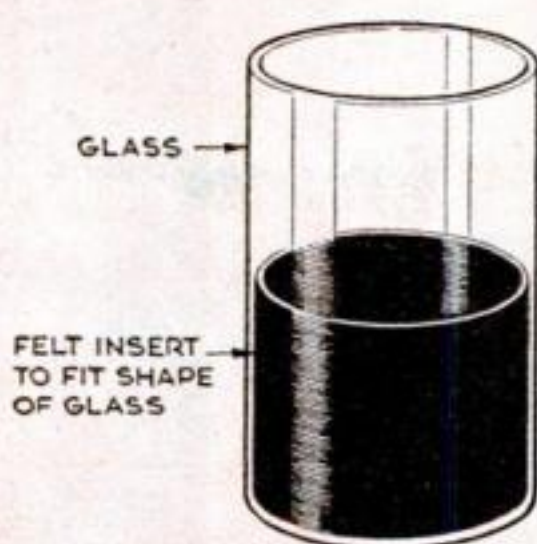
THAT OIL CALMS troubled waters has long been an accepted proverb. A variation of this physical principle makes it possible to perform an interesting experiment. Place an elongated loop of thread on water in a tumbler, making certain that the thread touches the surface at all points but that its upper edge is not submerged. Now drop a little salad oil or thin machine oil in the center of the ring. As the oil spreads, lessening surface tension inside the ring, the greater tension of the water outside pulls the thread into a nearly perfect circle.



MAGIC YOU CAN MAKE



FRONT AND BACK OF CARD

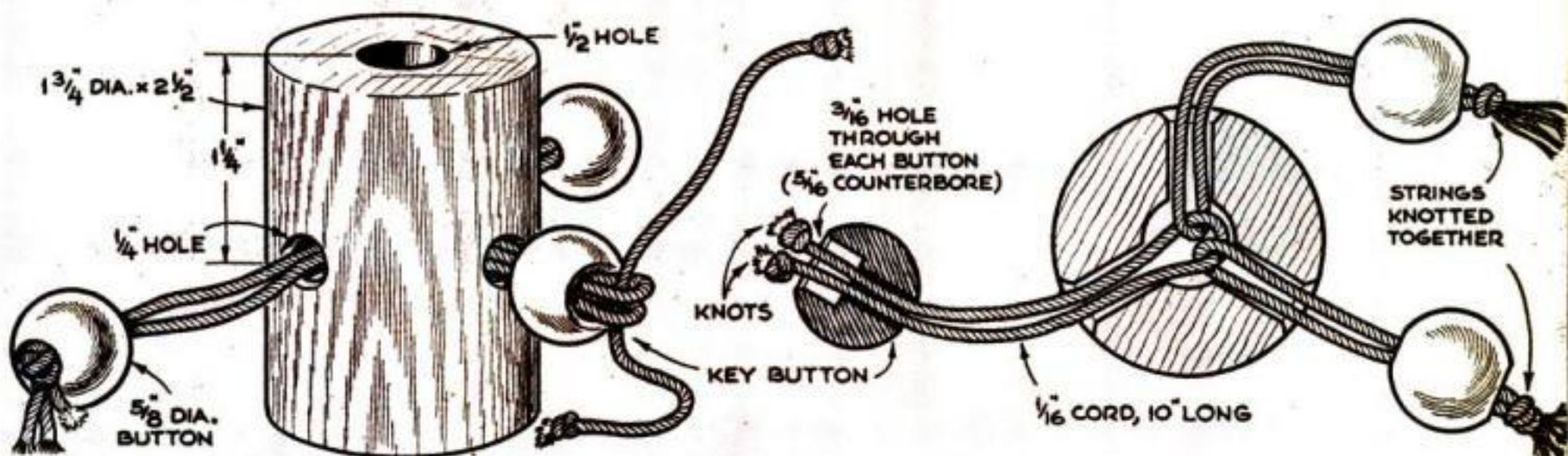


CHANGING INK INTO WATER may be possible chemically; it is definitely possible by magic—except that for the feat of magic you don't really use ink, or water either, for that matter. Your friends will be misled, however, by a cylinder of black felt cut from an old hat and inserted in a tumbler to make it appear half filled with ink. Take care to hold the tumbler level at all times.

Provide a card half black on one side and wholly white on the other. Show the tum-

bler and the white side of the card; then insert the card and pull it out, turning it quickly so the half-black side shows. It will seem to have been colored by the "ink."

Lay a large handkerchief over the tumbler and remove it, inserting a finger in the glass to pull out the felt cylinder as well. Pretend to sip the "water."—GEORGE BARR.



FREEING THE BUTTONS from the cords that hold them in a large dowel drilled as indicated above isn't difficult if you remember to tie the knots exactly as shown. The ends of two cords are tied with a single knot, but those of the third are knotted but not tied together. This won't be noticed by those who aren't in on the trick. To free the

buttons, pull this cord through its button and draw the looped ends of the other cords with it, as shown in the drawing at the left. Then slip the first cord out, and all the buttons can be removed.

When restringing the puzzle use a piece of wire as a needle. Pull the knots tight in the buttons for concealment.—G. B.

MOVING THE RINGS from one end peg to the other end is more difficult than it looks. One of the rules is that only one ring can be moved at a time and it cannot go on a smaller ring. It's an old Hindu trick.

Call the pegs L, C, and R, and the rings 1, 2, 3, and 4 from the smallest to the largest. Start with all on L, as shown. Then move this way: 1-C, 2-R, 1-R, 3-C, 1-L, 2-C, 1-C, 4-R, 1-R, 2-L, 1-L, 3-R, 1-C, 2-R, and 1-R.

Adding a fifth ring will make it harder.—G. B.

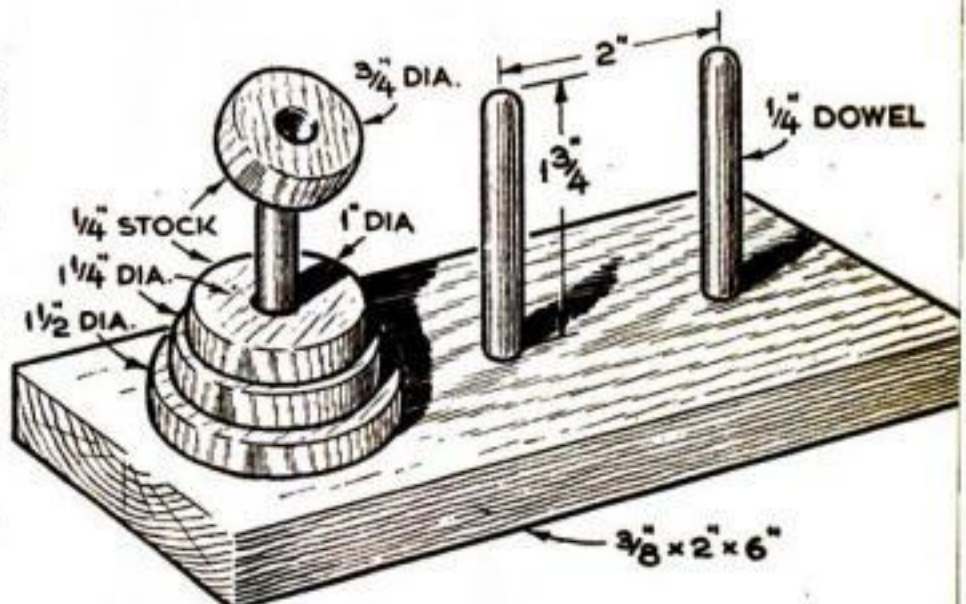
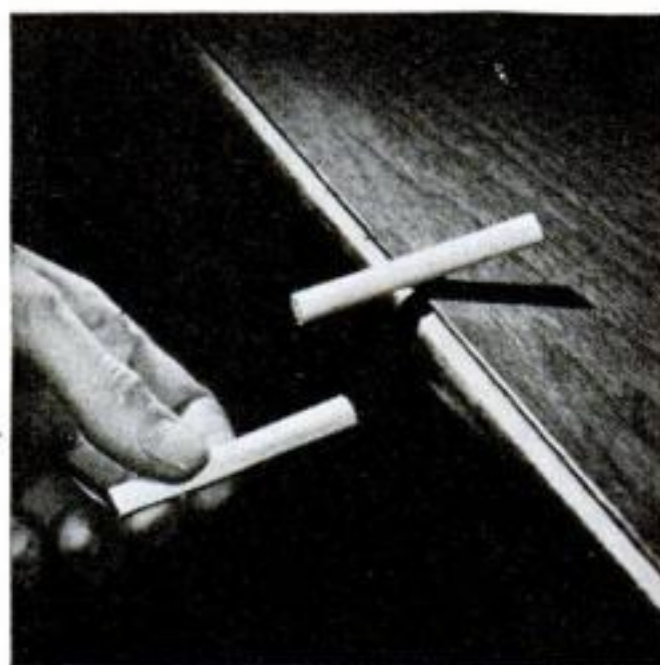


TABLE TRICKS

CRUSH AN EGG in your hand while holding it aloft. Then throw it on the floor. To the surprise of everyone, what falls from your hand is not a mangled egg at all—but a fluttering cloud of confetti! Just any egg from the refrigerator, of course, won't do. The insides must previously have been removed by making a $\frac{1}{4}$ " hole in one end, a smaller one in the other, and blowing through the latter. After the shell has dried, stuff it tightly with confetti and seal the holes with paper to match the color of the shell. If you crush the egg thoroughly when you do the trick, the fragments of shell will fall with the confetti and not be noticed.



BALANCE a cigarette carefully on the edge of a table and hold another just below. As the cigarette in your hand is lowered and raised, the other will follow suit. Whence comes this apparent magnetism? From your own breath, blown surreptitiously on the end of the upper cigarette as you bend low over it. ➡



↑ **AFTER BURNING** a strip of tissue paper and rubbing the ashes between your palms, can you pull the paper from your hand still unharmed? The trick is possible by using a duplicate strip, pleated into a tiny square and tucked under a ring against the back of a finger. Both palms then can be shown to be empty. While the paper is burning, bring the duplicate into the palm by turning the ring with the thumb.

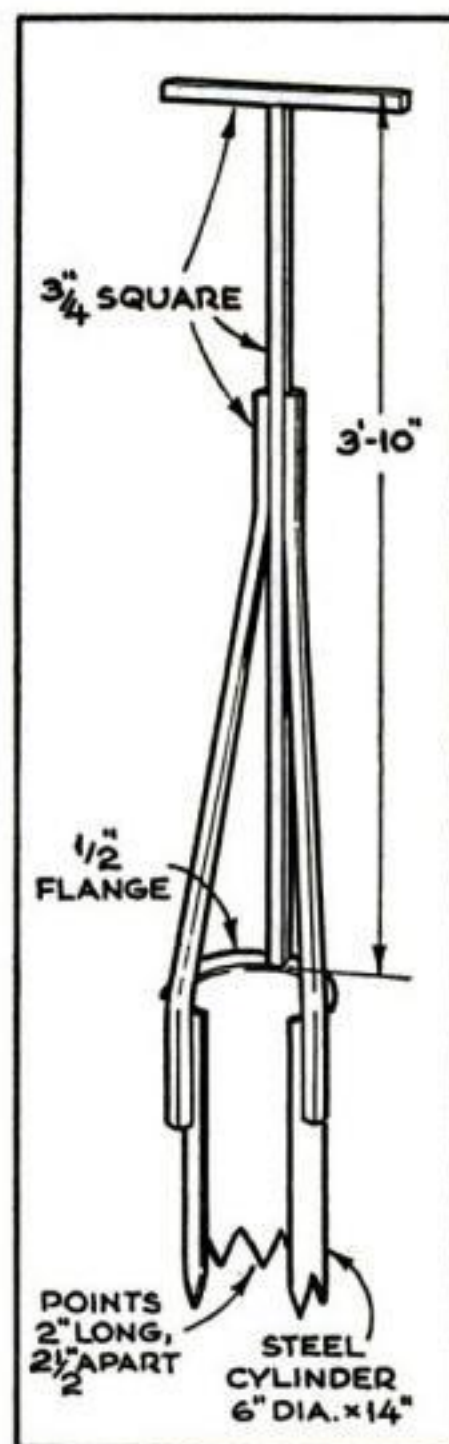
MAGIC INK that will disappear almost at the wave of a hand can be made by stirring a dozen drops of tincture of iodine and a teaspoonful of cornstarch into half an ounce of water. Use the ink with an ordinary pen. If you don't like what you've written, let the ink dry, give it a swish with a cloth—and it's gone!



WRITE SOMETHING on a slip of paper and seal it in an envelope. Then ask a volunteer to shuffle and cut a pack of cards, placing one heap face upward on a table. Lay the envelope on the face-downward heap and the rest of the pack atop it. Have someone open the envelope after first looking at the card directly under it. The name of that card will appear on the slip of paper! If you value your life, don't tell anyone that this card had been removed from the pack and concealed under the envelope.



Operated like an apple corer, this transplanter removes large plants from the ground with roots intact in a ball of soil. Ponderosa pine seedlings are being moved with it in the pictures above and at left.



Seedlings Moved Quickly with Little Loss

LARGE plants removed from the soil with a transplanter developed by Morley F. Brandborg, of the U. S. Forest Service, have an improved chance of survival because a ball of dirt remains intact about the roots. The digging part of the tool is formed from a length of pipe or a piece of $\frac{1}{8}$ " sheet metal. If pipe is used, cut away one fourth by making two lengthwise cuts. The sheet metal can be bent to shape. Cut notches

2" deep in one end and file the points sharp. Strengthen the other end by welding a $\frac{1}{2}$ " flange around it. To this end also weld an iron bar $\frac{3}{4}$ " square, and 3' 10" long, as well as two shorter supports of the same material. A square crossbar will make an adequate handle, but $\frac{3}{4}$ " pipe would be easier on the hands.—ALICE S. COOK.

Bottle-Holding Device Saves Work in Feeding Young Animals

IF HAND feeding is necessary to save the lives of calves, lambs, pigs, or other young animals, the bottle-holding device at the right will speed the job. It was devised by Mrs. Walter Peterson, of Milan, Ill., to feed pigs that faced starvation because they were runts in large litters. Bottles are held securely as the animal feeds.



New Fungicide Protects Seeds

AVAILABLE to gardeners this year for the first time, a fungicide produced by the United States Rubber Company permits a higher percentage of seeds to germinate by killing harmful fungi in the soil. A pinch of the powder, commercially termed Spergon, is dropped into a seed envelope and shaken up with the seeds before planting. The chemical may be handled without danger.

Watchdogs of Heat and Power *(Continued from page 108)*

called a thermopile, the minute quantity of heat coming from a star has been measured. The thermostats actuated by this means can regulate heat down to small fractions of a degree.

In its simplest form, a thermostat performs two alternative functions—turning something off or on, such as a valve or an electric switch. It becomes a little more complicated when it must graduate its regulation all the way from a maximum to a minimum. This may be done by gradually opening a damper, a valve, or a rheostat.

The primary movement of a thermostat is generally used to control another source of power, such as electricity, compressed air, or steam. When this is done, there is practically no limit to the amount of power that may be directly under control of a tiny instrument weighing a few ounces.

The room thermostat used with all furnaces that are controlled automatically is one of the simplest. Usually it consists of a bimetallic coil to which is attached a tongue. The end of the tongue stands between two electrical connections. A slight movement one way or the other makes a contact, and an electric motor then does a routine job, such as opening or closing a damper. Another common type of room thermostat is connected to tubes containing compressed air held to about 15 pounds of pressure. In these, the movement of the thermostatic element actuates valves so that the power of the compressed air does the work of damper opening and closing.

The most up-to-date heating systems employ an auxiliary thermostat that is placed outdoors and controls the heat output of the furnace in accordance with the weather, while the room thermostat, or several of them placed throughout the house, governs the temperature in its own area.

One of the simplest and most efficient bimetallic units is the disk that snaps when its temperature reaches a certain point. It is especially suited for making electrical contacts because of its instantaneous action. For this reason, such devices are employed by the millions as circuit breakers.

While the action of thermostats is essentially simple, their manufacture is quite a different matter, requiring the most exacting procedures in order to make them accurate and uniform in their movements. To make a bimetallic disk or strip that will bend back and forth with changes of temperature is not difficult, but to make thousands of instruments that will act the same under like conditions calls for engineering

skill and precision of the highest order. The selection of a type of thermostat for a given purpose is strictly the job of the expert. Flexible metal bellows are employed with a great variety of liquids for different kinds of functions and temperature ranges, and the amount of liquid used must be determined to a nicety in each case.

Many great factories and thousands of our finest engineers are engaged entirely in the creation of these seemingly simple instruments upon which we depend to such a great extent in this automatic age.

How Well Do You Visualize?

(Answers to problems on pages 82-83)

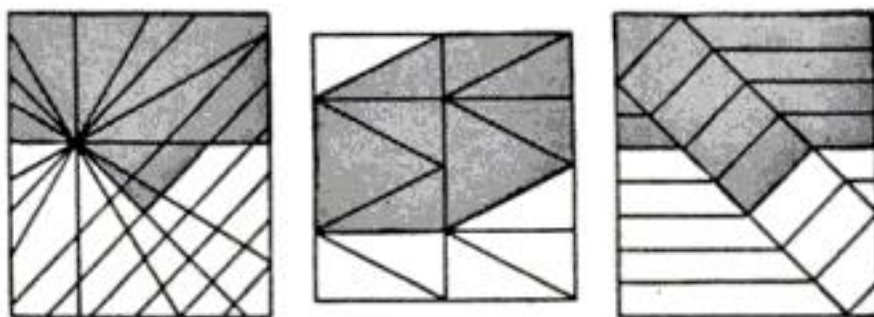
I. (1) B; (2) A; (3) yes; (4) yes; (5) 2; (6) 4.

II. (1) 2; (2) no; (3) 2.

III. (1) 1; (2) 2; (3) 2.

IV. Top row: Fourth flag from left. Second row: Third and fourth flags. Third row: Third, fourth, and fifth flags. Bottom row: Second, fourth, and fifth.

V.



VI. A touches five other blocks: B, four; C, five; D, six; and E, four.

VII. Left to right: Horse and buggy, locomotive, and woman at laundry tub.

VIII. First column: Bread, artist, pistol, pickles, sweater, window, blanket, highway, college, chicken, picture. Second column: Motor, lamp or lump, sugar, letter, ruler, husband, candy, rubber, hammer, water, cabin or cubic.

Subscribers in the armed services who notify us of change of address are requested to give us the key symbols appearing on the wrapper in which the magazine is received.

—ELECTRICAL ODDITIES—

NAMED "OLD LOUDMOUTH," a super loudspeaker developed by General Electric electronics engineers carries a whisper more than a mile and audible speech for three. Under ideal conditions it has been heard 18 miles away. Employing compressed air and mechanical adaptations of human speech, it is 150 times as powerful as the usual speaker. A gas-driven generator for power makes the unit fully portable, or it can be plugged into a 110 or 220-volt power line. It uses less than 25 watts of power.



TALKING AS HE WALKS, a soldier equipped with a special wire dispenser can now lay a communications line and keep in constant touch with headquarters by a field telephone. The dispenser, mounted on an infantry pack-board, weighs 25 lb. and contains 3,300' of wire which pays out as the soldier walks.



ONE TELEPHONE mounted on a long arm serves four men adequately in the Dayton office of Delco Products. When any one of the quartet wants the telephone, he presses a button, the arm swings, a chime sounds, and the instrument comes to rest at his elbow. Operated by a small motor, the sys-

tem was developed by the four men in their spare time. The motor shuts off when not in use and a slip clutch prevents damage should anything impede the arm. If the telephone is in use, a second man can press his button and, after the receiver has been hung up, the instrument comes to him.

Four men use one telephone in this office. It will swing to any one of the four if a button is pressed.



Air War: The USAAF

(Continued from page 96)

Flying Tigers muster more than 71 pilots or 55 outmoded P-40's. The average odds against them were as high as nine to one. Yet they won every combat they entered. They proved a point of importance to American aircraft design as the war got older. It was that a man mounted in a staunch airplane fitted with armor, self-sealing tanks, and superior firepower—which meant added weight—was better than a man flying a highly maneuverable, faster-climbing plane of less firepower that would come apart if it received one good burst.

It was a heartbreaking job, stopping the ubiquitous Jap and then trying to root him out of Melanesia, New Guinea, the Dutch East Indies, and the Philippines. New AAF airplanes were off the drawing boards and in being, but it took no tally sheet to count them. Jap planes, ferried from island to island—Tokyo's "unsinkable aircraft carriers"—swarmed down upon any point where AAF planes had the boldness to concentrate. Gradually, and only gradually, were enough planes delivered to American pilots to attain a numerical showing that was anywhere near equality. For months their superiority over the Japs lay solely in brainier flying and better tactical teamwork.

With the opening of the Papuan campaign in July, 1942, the Allied Air Forces began successfully to parry the Jap thrusts. The U. S. Army Air Forces were just what they sounded like—a series of self-contained striking units—and a newly constituted AAF unit pointed up the Southwest Pacific attack. It struck at enemy shipping and bases, carried troops and supplies, and co-operated in ground actions. It worked with ground and naval forces in the landings on New Guinea and New Britain. By 1943, the AAF was spearheading the amphibious advances into Jap waters and preparing the way for America's return to the Philippines.

In Europe the start was equally slow. It was another kind of warfare there. To Europe went the heavy bombers to vindicate this country's faith in the principle of the strategic assault on the source of the enemy's power to make war—his factories and his transportation system. It was the mission of the Allied air forces to prepare the way for the reduction of Hitler's Fortress Europe. The pre-invasion function of those air forces was twofold: to achieve air superiority by destroying the Nazi aircraft and synthetic-fuel industries and by burning up Luftwaffe planes in the air and on the ground; to so damage Nazi transportation facilities that the enemy could not move

men and supplies into the area of impending battles.

Early in 1944 the heavy bombers, raised at last to sufficient numbers and accompanied by their fighter cover, began reaching deep into Germany to strike such aircraft manufacturing centers as Regensburg, Brunswick, and Augsburg. Not one American air force but two, based on England and on Italy, took up the burden, and their operations were as beautifully dovetailed as a cabinetmaker's pieces cut exactly to size. On March 6, American bombers made their first attack in force on Berlin. The bomber offensive had a valuable by-product—it kept a large part of the Luftwaffe in Germany, busy with the defense of the homeland. In the month of May, intensified attacks were made on marshaling yards, bridges, rolling stock, and enemy defenses along the French and Belgian coasts. To protect England, the springboard for the coming invasion, other attacks were made on the V-1 winged-bomb launching sites in the Pas de Calais and Cherbourg Peninsula areas.

The performance of the American Air Forces on D-Day was a sort of symbol of the versatility of the heavy bomber as an artillery piece. Abruptly, more than 2,500 "heavies" were switched from strategic to tactical bombing to "isolate the battlefield" in Normandy. The Luftwaffe was through.

If the American conception of the employment of airpower was correct, it could be applied to Japan as well. From the Flying Fortress and its companion piece, the four-engine Consolidated Liberator, it was only a step to the Superfortress and the Consolidated Vultee Dominator. Less than three years after Pearl Harbor the one-thousandth VH (very heavy) bomber had been produced.

From the freshly won Marianas Islands, Superfortresses speared north to Tokyo and its satellite industrial cities, the source of the Jap's military effort. From China other Superfortresses blackened the industry and the ports of Kyushu in southern Japan. It was the beginning of the end for the Greater East Asia Co-Prosperity Sphere. The Jap had reckoned without airpower in its ultimate application, the delivery of explosives over vast distances.

As late as November 1918, Army aviation consisted of about 11,000 pilots and an overall personnel strength of around 190,000. Today, as it hammers at the Jap's last citadel, the AAF is numbered in millions of men, scores of thousands of aircraft. The AAF has come of age.

War machines that save lives



In no other war, and in no other country, have greater precautions been taken by military leaders and industry to safeguard the lives of fighting men.

Artificial fog to conceal troop movements... Electric blankets to protect wounded airmen... Solar searchlights to improve chances of rescue for shipwrecked men... These are just a few of the war machines that *save* lives—in which G-E research and engineering played a part. *General Electric Company, Schenectady, N. Y.*



Stealing the enemy's eyes. Our soldiers carry their "fog" with them, mobile smoke generators that blanket battle areas in dense white mist. New U. S. smoke machine uses a

new principle of smoke generation worked out in the General Electric Research Laboratory by Dr. Irving Langmuir. These machines have saved many American lives.



Solar searchlight designed by General Electric, in cooperation with National Bureau of Standards, gives flyers and sailors adrift at sea a way to signal rescuers as far away as ten miles. Most important problem was to find a method of aiming mirror so pilot of plane would catch reflection of the sun.

★

Hear the G-E radio programs: *The G-E All-girl Orchestra*, Sunday 10 p. m. EWT, NBC—*The World Today* news, Monday through Friday 6:45 p. m. EWT, CBS—*The G-E House Party*, Monday through Friday 10:00 p. m. EWT, CBS.

FOR VICTORY BUY AND HOLD WAR BONDS



Diagnosing flyers' troubles. Photos of subjects in high-altitude test chamber, taken with G-E x-ray equipment, show formation of tiny gaseous bubbles in tissues and joints, a condition described as more painful than rheumatism. X-ray studies like this help answer what happens in high-altitude flights.



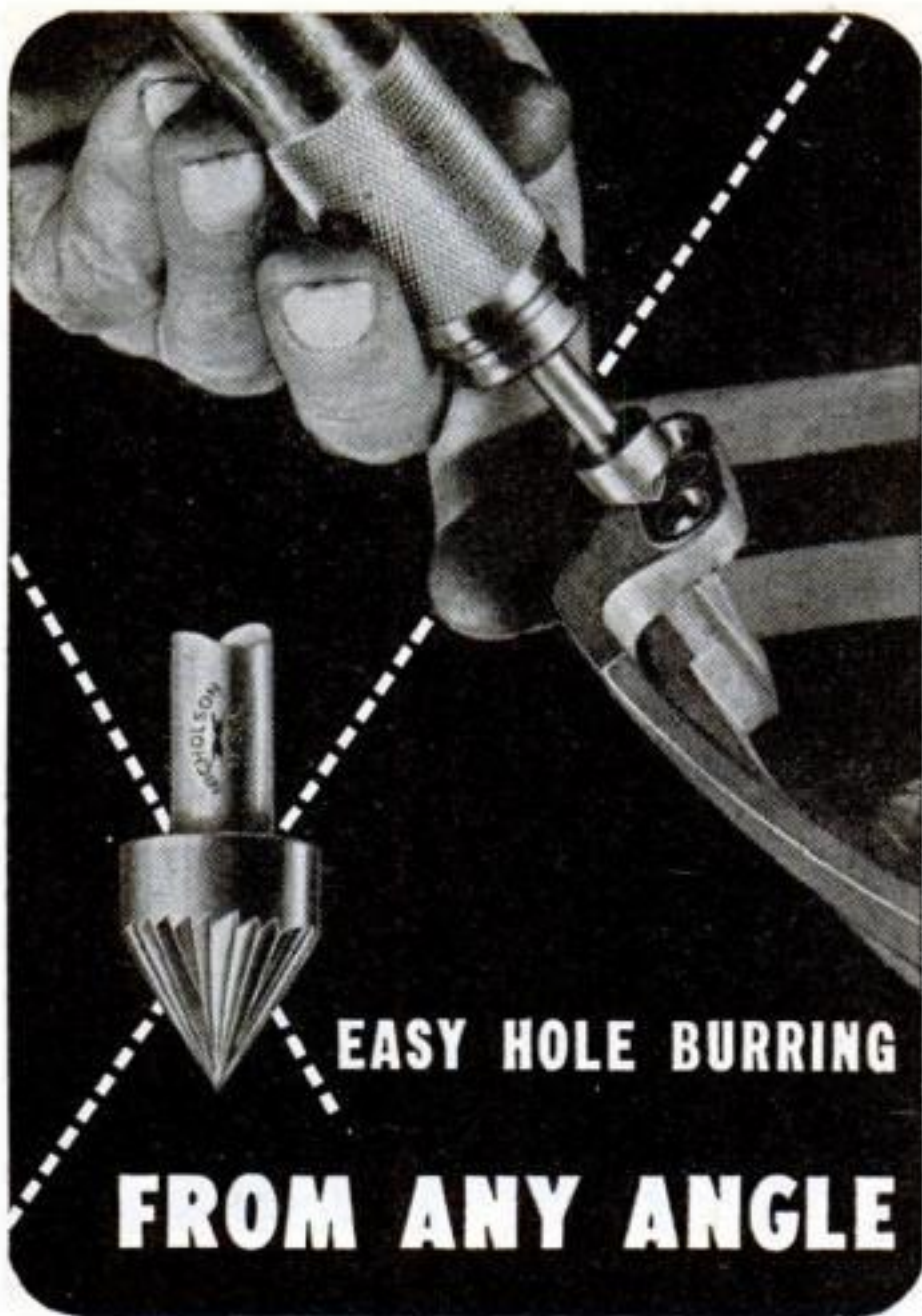
Blanket saves flyers' lives. In high-altitude bombers, wounded airmen need emergency protection against freezing cold. Now General Electric is supplying the Army Air Forces with electrically heated "casualty blankets" that automatically maintain a protective warmth in temperatures as low as 60 below zero.

GENERAL ELECTRIC

Buy War Savings Bonds and Stamps regularly.

193

AUGUST, 1945



A NICHOLSON 60° Cone Shape Rotary File in the chuck of a portable tool offers just about the handiest, "time-savingest" method there is for burring or countersinking holes in irregular parts or products; or for removing burs left by screw machine when cutting inside threads.

Most important thing about Rotary Files is, of course, quality. It is the first thing Nicholson thinks about, for quality is the priceless heritage of 81 years of Nicholson adherence to high file-making standards. You can be sure that Nicholson Rotary Files are *right* in every respect: manufactured from high-speed steel; carefully shaped and true-centered; accurately cut; expertly hardened.

16 STANDARD SHAPES, in either Ground (illustrated) or Hand Cut (like regular round files); 3 cuts—Coarse, Medium, Fine; stock diameters $\frac{1}{8}$ " to $1\frac{1}{8}$ ". Catalog and Price List mailed, on request, to industrial and training-school managements.

NICHOLSON FILE CO., 90 Acorn St., Providence 1, R. I.
(In Canada, Port Hope, Ont.)

**NICHOLSON
ROTARY FILES**

(Hand Cut and Ground)

FOR EVERY PURPOSE

**NICHOLSON
U.S.A.**

Redeploying the AAF

(Continued from page 80)


groups had received orders to move from Europe to the Far East. This number of Flying Fortress and Liberator groups adds up to 960 bombers, plus spares. These will be flown to the Pacific areas, carrying with them combat crews and some 650 tons of immediately needed equipment. The air echelon required to keep 'em flying after these bombers arrive includes 4,440 specialists and technicians, and the task of redeploying these men demands the use of 960 Skytrain or Commando transport planes—a fleet of planes that would take about four hours to pass over any given point.

But this is the easiest part of the redeployment. The relatively simple expedient of transporting the planes, men and matériel by air presents none of the difficulties facing those who must prepare for the movement of the remaining personnel and equipment of the 20 bomber outfits. On the ground are left some 22,000 men and 15,800 tons of miscellaneous ground equipment that includes everything from bulldozers and $2\frac{1}{2}$ -ton trucks to hardware such as socket wrenches and nuts and bolts.

Railroad transportation of this complement to the nearest port will require 2,140 flat cars, 520 boxcars, 484 coaches, and 200 kitchen and baggage cars. To embark these men and matériel, 10 Liberty ships and nine Army transports will be needed. Not taken into account is the stockpile of food and other essentials these men will consume during the 14,000-mile voyage to some Pacific point such as Manila.

The moving of fighter outfits will be a slower and more complex operation. It is not practical to ferry even the long-range Mustangs, Thunderbolts, Lightnings, and Black Widows over such distances. These

(Continued on page 198)



Model Builders Attention!

	V	V-2	V-3
Hex	$\frac{1}{2}$ "	$\frac{3}{8}$ "	$\frac{5}{16}$ "
Thread	$\frac{3}{8}$ "-24	$\frac{1}{4}$ "-32	$\frac{1}{4}$ "-32
Thread Length	$\frac{7}{32}$	$\frac{7}{32}$	$\frac{5}{32}$
Weight, Grams	8	$3\frac{1}{2}$	$2\frac{1}{2}$

Actual Size V-Plug

Champion spark plugs for model gas engines give the same dependable performance as regular Champions. Sillment sealed. Sillimanite insulator. Alloy needlepoint electrodes for easy starting. One piece construction.

CHAMPION

SPARK PLUG COMPANY • TOLEDO 1, OHIO

American Flagships like this DC-6 are now on order for delivery as soon as war needs permit. The ultimate in comfort and luxury, they will take you coast-to-coast in approximately 8½ hours.



Now AMERICAN AIRLINES SPECIFIES DEPENDABLE CHAMPION SPARK PLUGS 100%

American Airlines, Inc., the nation's largest domestic airline—in miles flown, passengers carried and planes operated—now specifies Champion Spark Plugs 100%. This tribute to Champions is directly traceable to "better performance, longer life, less servicing time, and lower operating costs."

Thus once again the qualities which have made Champions first choice of motorists, and outstanding in aircraft engines, both military and commercial,

are convincingly and emphatically confirmed.

Champion Spark Plugs for your car have the same heritage of prestige and better performance as these aircraft types. The same basic materials, research, engineering and manufacturing are back of every Champion regardless of type. Now more than ever it will pay you to insist on the spark plugs that are Champions in fact as well as in name.



CHAMPION SPARK PLUGS

CHAMPION SPARK PLUG COMPANY, TOLEDO 1, OHIO

AUGUST, 1945

Buy War Savings Bonds and Stamps regularly.



**TO SAVE
GASOLINE
—KEEP SPARK
PLUGS CLEAN**

195

Ingenious New Technical Methods

Presented for Your Peacetime Use



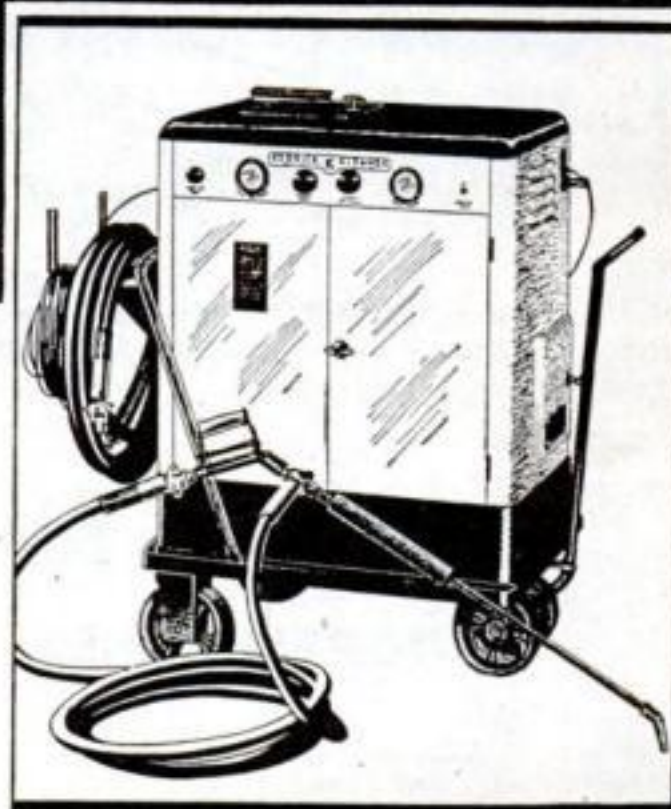
Coming to Users of Gas-Powered Equipment 80% SAVINGS IN CLEANING TIME with Steam Rig Now the Army's Standby

An economical solution to the problem of cleaning and degreasing trucks, passenger cars, tractors, locomotives, excavators and the like will be available to garages, service stations, all users of oil-burning equipment, as soon as war demands permit. It is a more efficient steam cleaner now in use by the thousands in the Armed Forces.

Neat "housekeeping" has too often been neglected by industry due to the costliness of hand labor. But the best housekeepers in the World, the U. S. Army, Navy and Marine Corps, dare not neglect frequent and thorough cleaning of all equipment to safeguard against fire and malfunctioning, and to permit fast, certain inspection. This cleaner, developed to meet their high standards, removes grease, dirt and grit 5 times as fast as any other method. It cleans by a balanced combination of heat, detergent, water and friction. It is typically "army" in simplicity of design and operation; in 30 minutes, the entire machine can be dismantled and completely cleaned.

Wartime uses of Wrigley's Spearmint Gum also point the way that industry may benefit when this quality product again becomes available. It will *again* be a "help on the job" in many ways. Right now *no* Wrigley Spearmint Gum is being made, as present conditions do not permit the manufacture of Wrigley's Spearmint in quantity and quality sufficient for all. But remember the Wrigley's Spearmint wrapper—it is a certificate of highest quality and flavor—and will always remain just that.

*You can get complete information from
Clayton Manufacturing Company, Alhambra, California*

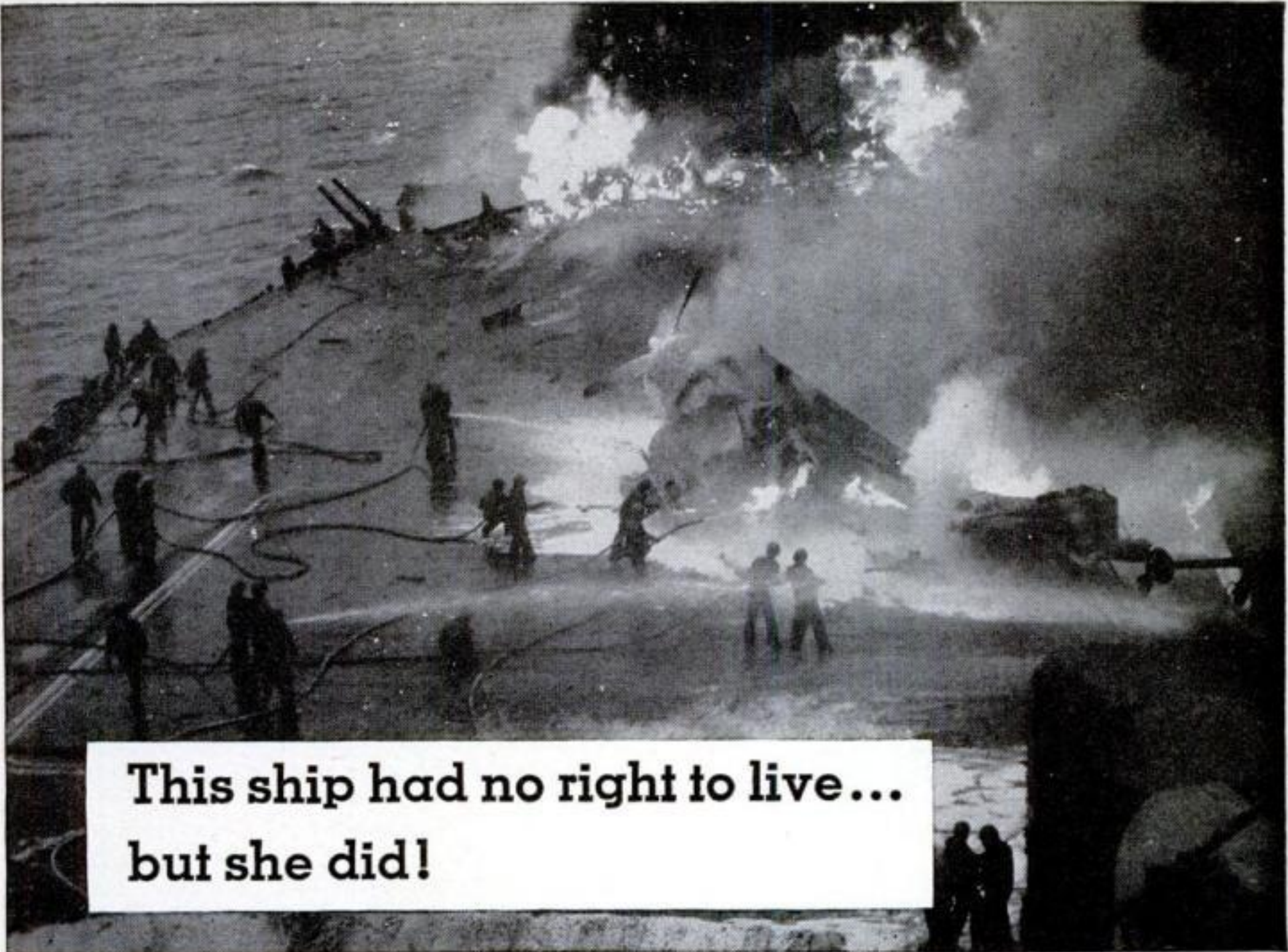


The Kerrick Kleaner



Remember this wrapper

Z-77



This ship had no right to live... but she did!

This is your aircraft carrier *Saratoga*—the oldest in the fleet.

She was one more entry on a swelling list of American ships . . . *ships so badly damaged that they have no right to live!* According to all rules and experience, her hurts were grievous enough to put her on the bottom.

But *her crew* of American seamen collectively refused to recognize the rules.

They brought her back!

The survivors of what should have been her death, brought her back more than 5000 painful miles so that her shattered flight decks could be mended, her ripped plates replaced, her seared super-structure renewed.

They brought her back because they had implicit confidence in American ability to repair and re-fit her.

They brought the "Sara" back so she could fight again!

The "Sara" is back in action, today!

But here's the sore spot: A lot of critical ships *aren't* back in action! American shipyards are jammed with battle-damaged shipping. The pressure of repair work on fighting and supply ships mounts every day.

The need for skilled workers to keep up repair schedules is terribly urgent.

How soon these ships return to action, depends on us at home. On how well we understand the stupendous naval problems of the Pacific!

- ✓ It takes 3 ships in the endless Pacific to do the supply job that 1 ship did in the Atlantic.
- ✓ 6 to 11 tons of supplies are required to place a man in the Pacific theater—an additional ton per month to maintain him.
- ✓ Yet under ideal conditions, a

supply vessel can average but 2 round trips per year.

- ✓ In taking the shortest route to the nearest base capable of repairing them, some of our ships have had to sail $\frac{1}{2}$ the circumference of the world.

But after 170 years of dealing with the American temper, the Navy is confident that the schedules *will* be maintained . . . that the damaged ships will be put into action again before Japan is whipped. And the Navy knows its Americans.

Didn't they bring the "Sara" back?

SPERRY

CORPORATION

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FORD INSTRUMENT CO., INC.
SPERRY GYROSCOPE CO., INC.
VICKERS INC.

Waterbury Tool Division, Vicker, Inc.



for
Storm at sea



OR
WHEN YOU LEFT THE WINDOWS OPEN



VALSPAR
STANDS UP FINE!

Even driving rain standing for hours on a Valsparred floor won't hurt it—because **Valspar never turns white!** Today as for over a century Valspar meets the toughest tests of all, giving full protection and lasting beauty. Always use Valspar in your home—takes only a few hours to dry!



Redeploying the AAF

(Continued from page 194)

fighters will be shipped, along with their combat crews, service personnel, and essential equipment.

Comparatively few fighters will be sent from Europe to the Pacific. Only the latest modifications, and those in the best condition, are to be redeployed. Others will be returned to the U. S. for limited use; still others are being scrapped for salvage. One officer of the Air Technical Service Command, whose job it is to supply the combat units, said, "It would save a lot of time, trouble, and expense to burn on the spot every small airplane that we won't use against the Japs!"

Fighters that will be used are being ferried from their unit bases to ATSC "processing centers" which are modeled along the lines of the Port Newark and Oakland Overseas Command bases, through which passes the flow of new aircraft to the Pacific combat theaters. These centers in Europe will be as painstaking in their work as the huge installations here at home; there can be no short cuts in this phase of redeployment. We cannot afford to ship a fighter from 10,000 to 14,000 miles and have it arrive unfit for immediate use.

If we consider the redeployment of, say, ten fighter groups, each comprising some 75 planes and 1,000 men, plus spares and equipment, it adds up to a fair-sized convoy in itself. Thirty-three Liberties and tankers will be required to hold the planes and some packed parts; five Victory ships and five transports will be needed to move the men and the heavier equipment. More than twice the shipping used to move 20 heavy-bomber groups is necessary to move only ten fighter groups and their planes.

The men from the European theater who will fly these planes are being given short indoctrination courses to acquaint them with the new planes and the operating conditions they will encounter in the Pacific. For the most part, these differences involve more over-water flying, more low-altitude flying in all operations including strategic bombing, and the increased use of rockets. Pilots who flew Marauder medium bombers in Europe are undergoing a three-months transitional course in A-26 Invaders; so are some of the men who flew Mitchells. Only the latest B-25 modifications are being sent to the Far East, and these carry rockets.

"If those Nips," declared a procurement officer sagely, "had any idea today how big this thing really is and what we're getting ready to throw at them tomorrow, they'd have surrendered yesterday!"

*Now—you have Sealed Beam
Lighting at its Best*



KEEP BUYING
WAR BONDS



GUIDE LAMP DIVISION OF GENERAL MOTORS

Guide Sealed Beam headlamp units fit all vehicles equipped with Sealed Beam headlamps. They give you Sealed Beam lighting at its best because, throughout their life, they *will not grow dim—will not burn out* if an accident should crack the lens.

Guide Sealed Beam units cost no more than other makes. They safeguard your ride "all the way"—no dim-out, no black-out.

NO DIM-OUT—because Guide Sealed Beam units are sealed against dirt, dust and traffic film. They stay bright for the life of the unit—do not lose their efficiency, as earlier-type headlamps do.

NO BLACK-OUT—because Guide Sealed Beam units provide the double protection of a bulb within the sealed unit. If the lens is cracked they do not fail—light the way safely until the damaged unit can be replaced.

LET SAFETY SHARE THE RIDE — REPLACE WITH GUIDE



When it's an EXIDE... you start

Confidence in a dealer is inspired by good service and good merchandise. Generally you will find such a dealer where products of KNOWN high quality are featured—brands whose merits have won widespread recognition.

THE ELECTRIC STORAGE BATTERY COMPANY
Philadelphia 32

Exide Batteries of Canada, Limited, Toronto



BUY TO LAST

IT TAKES MORE THAN A LUBRICANT to make your car "feel" better



The very best lubricant cannot keep your car chassis in good condition unless it *stays* on the job. Summer heat will cause ordinary grease to flow right off bearing surfaces. A lubricant lacking in cohesive and adhesive properties is squeezed out of bearings by the continuous jouncing of your car as you drive along. In the absence of the cushioning effect of the lubricant, road shocks are transmitted to the car chassis. Your car no longer rides smoothly.

Marfak chassis lubricant is scientifically designed to overcome these faults. You can *feel* its cushioning effect as you drive. Figures 1 and 2 show that the combination of its ingredients gives Marfak both cohesive and adhesive qualities so that it resists flow-out, jar-out,

wash-out and squeeze-out. *You can feel the difference!*

Marfak also resists oxidation that causes ordinary lubricants to dry out and gum up. Marfak stays fresh right up to the time your car is ready for another lubrication job. That's why Marfak keeps chassis joints limber, reducing wear and saving money by eliminating costly repairs.

Change to Marfak today! It will keep your car on the road!

THE TEXAS COMPANY



Figure 1. Marfak resists tendency to flow when heated. Ordinary lubricant flows under the effect of heat.



Figure 2. Marfak cushions the blow, sticks to the job, doesn't spatter when given the hammer test. Ordinary lubricant spatters in all directions, flying away from the job.



Don't miss the **TEXACO STAR THEATRE** on Sunday nights with **JAMES MELTON** and famous guest stars. See your newspaper for time and station

You're welcome at **TEXACO DEALERS**

Let us
MARFAK
your car



PRESERVING summer perishables for winter use puts a tremendous pressure of haste and timing upon the canning industry. Fruits and vegetables are whisked from orchard and garden to kettle by great fleets of trucks, *more than half of which are equipped with AC Spark Plugs*, chosen for utmost reliability. *Gasoline is saved and spark plug life prolonged* on many of these trucks by following the AC plan of cleaning and regapping the plugs every 3,000 miles, replacing worn plugs with new AC's of the right Heat Range for today's fuels. Try this plan yourself. It will save time, money and materials, on your car, truck or tractor.

AC SPARK PLUG DIVISION • GENERAL MOTORS CORPORATION



CLEAN SPARK
PLUGS SAVE UP
TO ONE GALLON
OF GAS IN TEN

SPARK PLUGS

SPEED FINAL VICTORY—BUY WAR BONDS

A Flying Vacation

(Continued from page 56)

on the compass and climbed it to 4,000 feet. That was higher than I ordinarily flew, but I wanted plenty of altitude over the terrain. We were qualified to fly only by "contact." If the weather should close down, we would have to land. Only more accomplished pilots than we could "go on instruments."

The sky remained clear. The soft contours of hills went by underneath. At no time were we more than a few miles from one of Pennsylvania's magnificent landing fields.

Dead ahead were the neat outlines of the Harrisburg airport runways. I put on the earphones for the receiving half of our radio and Groenhoff plugged in the transmitter on his side of the instrument panel. I turned the power button and put the pointer on 278 kilocycles, the standard airport control frequency.

"Harrisburg tower from Aeronca 36989, over," I said into the transmitter, giving the Approved Type Certificate number of our plane.

"Nine-eight-nine from Harrisburg tower," came the answer, "go ahead."

"Harrisburg tower from 989, veering north of field at 1,000, landing Harrisburg, instructions please, over."

"Nine-eight-nine from Harrisburg tower, follow the plane in on your right." He gave us the wind velocity and the runway we were to use.

"Harrisburg tower from 989, Roger."

We skimmed in. The wheels touched and stuck.

"If you are heading west," volunteered one of the local flyers, while the ship was being gassed, "I'd suggest landing at Latrobe."

"Why not Pittsburgh?" asked Groenhoff.

"Pittsburgh often is weathered in when airports around it are in the clear."

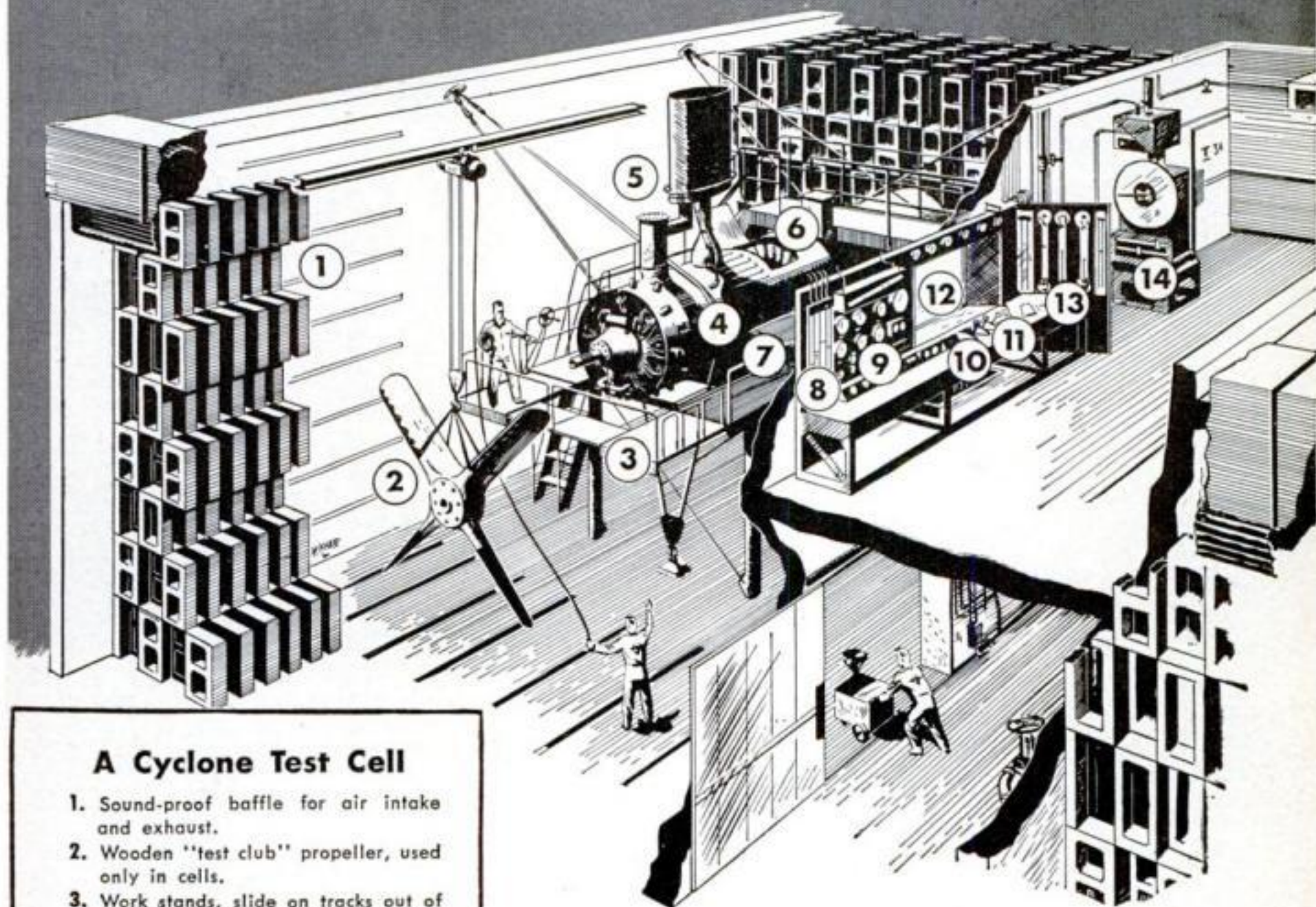
Now it was Groenhoff's turn at the controls. I took the maps.

We were off again. The hills became mountains. It was hard work reading the maps. Groenhoff was a better navigator than I, and I knew it. I would be red-faced if I got him off course. A cross wind was blowing, and we had to compensate for drift by "crabbing"—pointing the nose of the plane slightly into the wind.

We found the Latrobe airport after hunting for it for five minutes. Cross-country pilots almost always have to hunt for this type of field, small and grass-covered. Few

(Continued on page 206)

Tunnel to TOKYO



A Cyclone Test Cell

1. Sound-proof baffle for air intake and exhaust.
2. Wooden "test club" propeller, used only in cells.
3. Work stands, slide on tracks out of propeller's way.
4. Engine mounting tube, and three-point cable suspension.
5. Carburetor air supply; air comes from separate blower.
6. Suction cooling fan, to help test club cool engine.
7. Duct for fuel, oil lines, also instrument connections.
8. Manifold pressure gauges.
9. Oil pressure gauges and oil temperature thermometers.
10. Engine throttle.
11. Fuel mixture control.
12. Observation window.
13. Gasoline flow meters.
14. Scale to weigh oil consumed during engine run.

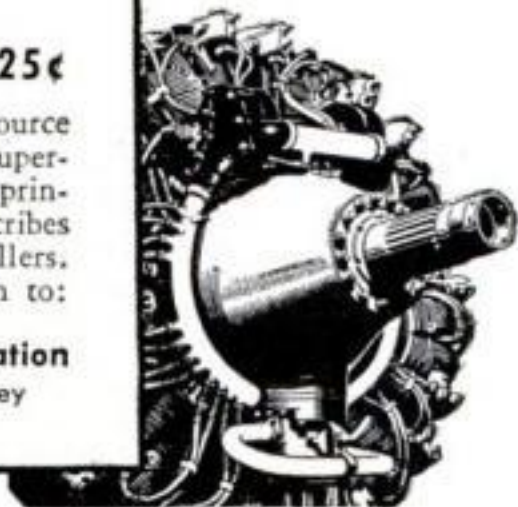
Send for "ENGINEOLOGY"—25¢

Learn more about aviation's source of power. Enginology explains supercharging, combustion and engine principles in non-technical terms; describes their relation to planes and propellers. Just send 25 cents in U.S. coin to:

Wright Aeronautical Corporation
Dept. PS, Paterson 3, New Jersey

The tunnel is a concrete test cell, where a Wright Cyclone Engine built to power a Boeing B-29 Superfortress first roars into life. Behind soundproof walls, test engineers run it up well past 2200 HP, check its performance and fuel and oil consumption.

After the 3½ hour test, the "green" Cyclone is disassembled and each part inspected. A second time it is assembled and run for 3 hours in a final test. Every Cyclone is thus twice assembled, twice tested. It is the way Wright Aeronautical double checks precision construction and assures Cyclone performance in the air.



WRIGHT

AIRCRAFT ENGINES

DIVISION OF
CURTISS WRIGHT
FIRST IN FLIGHT



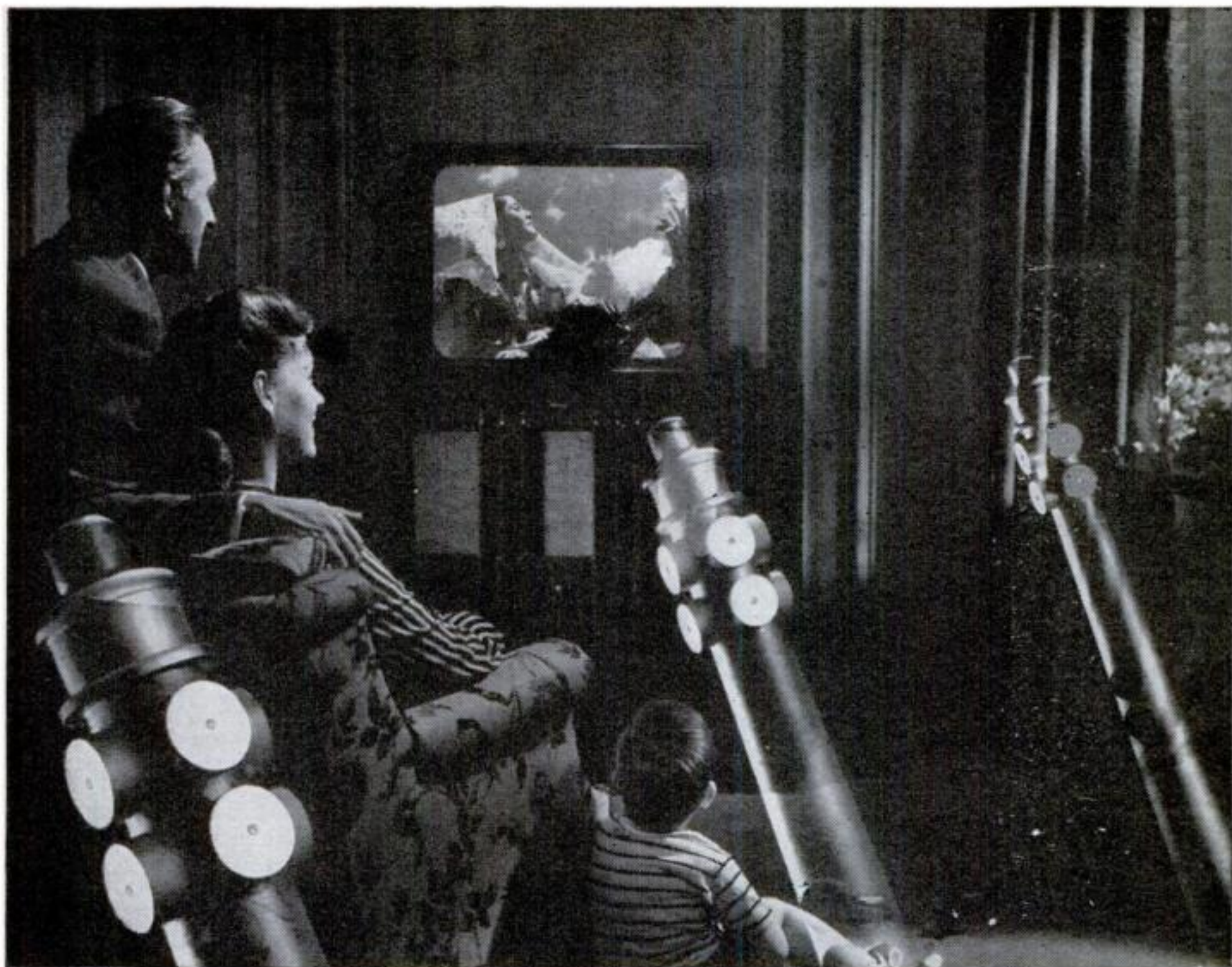
Enjoy Life with

Miller

HIGH LIFE



MILLER BREWING COMPANY • MILWAUKEE, WISCONSIN



RCA radio-relay towers—like those above—will give post-war television far greater range.

Coast-to-Coast Television... through "Radio-Relay"

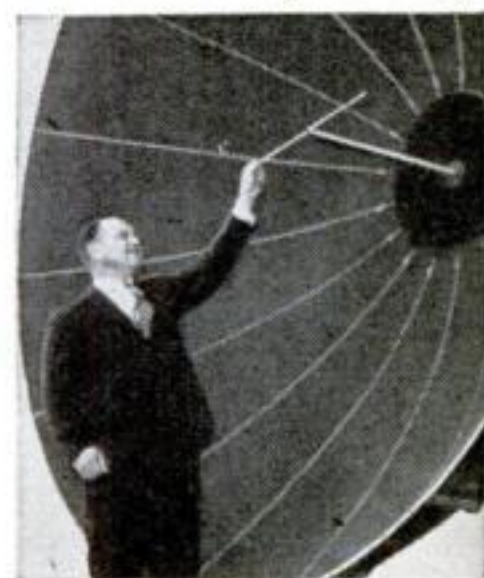
For a long time it looked as though post-war television might be confined to local stations. That was because the ultra short waves that carry television do not bend with the curvature of the earth. They go in a straight line out to the horizon—and then into the sky.

But today, this handicap has been overcome—by RCA scientists and engineers.

The *radio-relay* was developed—a tower that "bounces" television programs to the next tower 30 to

50 miles away. Through a network of these automatic, unattended, radio relays, coast-to-coast television is made practical.

This is but one more example of how RCA research constantly "makes things better." Such research is reflected in *all* RCA products. And when you buy a television set, or radio-phonograph, or anything made by RCA, you enjoy a unique pride of ownership. You can be sure it is one of the finest instruments of its kind that science has achieved.



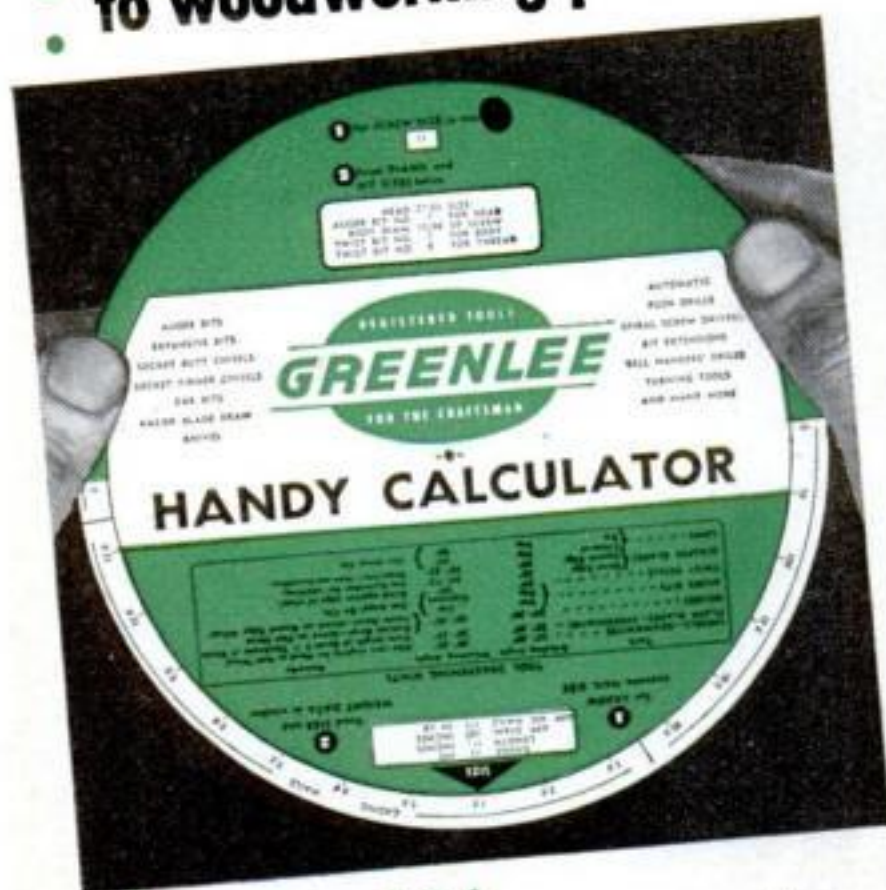
C. W. Hansell, RCA specialist in transmitters and relays, is shown here with a new and enlarged radio-relay reflector that can, "bounce" radio messages, radiophotos and Frequency Modulation programs at the same time that it relays television from coast to coast!

RADIO CORPORATION of AMERICA

PIONEERS IN PROGRESS



QUICK SOLUTIONS to woodworking problems



- **Only 10¢** for this easy-reading GREENLEE Woodworker's Calculator. With it you swiftly convert linear feet to board feet...get slope per foot in degrees...compare hardness, weights, shrinkage, warping, working ease of various woods.
- Also—bit sizes for head, body, thread of screws...nail specifications...tool sharpening hints...protractor. 6" diameter. Heavily varnished cardboard. Special offer...send coupon and 10¢ (not stamps). Greenlee Tool Co., Rockford, Illinois.



Makers of high-quality woodworking tools—auger bits, chisels, gouges, spiral screwdrivers, and many more.

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ROCKFORD • ILLINOIS

☐ Enclosed is 10c. Send your "Handy Calculator" by return mail.

Name _____

Address _____

City _____ State _____

A Flying Vacation

(Continued from page 202)

of the thousands of private flying fields throughout the country are marked with the "standard" circle or other identifying sign.

The airport manager-operator had room for our ship in his hangar. We decided to spend the night. A motorist gave us a lift into town and dropped us at a hotel. That evening we spent an hour and a half planning the next day's flight. We checked the Pittsburgh weather station in the morning. The weather was "good" but a low-pressure area was centered in Wisconsin. Strong winds could be expected from the southwest.

The winds blew. At times the gusts reached a velocity of 40 miles an hour. We estimated that by constant rechecks on our ground speed. The air was fairly rough and the plane's controls required constant attention, but navigation became simplified. Once we emerged from the mountains, the east-and-west roads made perfect drift meters.

For me, at least, half the fun of a flying vacation is in the flying. We gawked at the countryside. We watched chickens scurry for cover as we droned by. Chickens, by the way, are the only farm livestock that will run from a plane flying over. We disproved, by observation, a fond theory of some airmen that cattle always graze with their tails to the wind. We took turns identifying towns and cities. At a distance, communities always appear as a dark smudge on the landscape.

At Indianapolis, our final stop for the day, we began a weary search for a field we had pencil-marked on the map. It wasn't there.

"It has to be," I said, "the map says so."

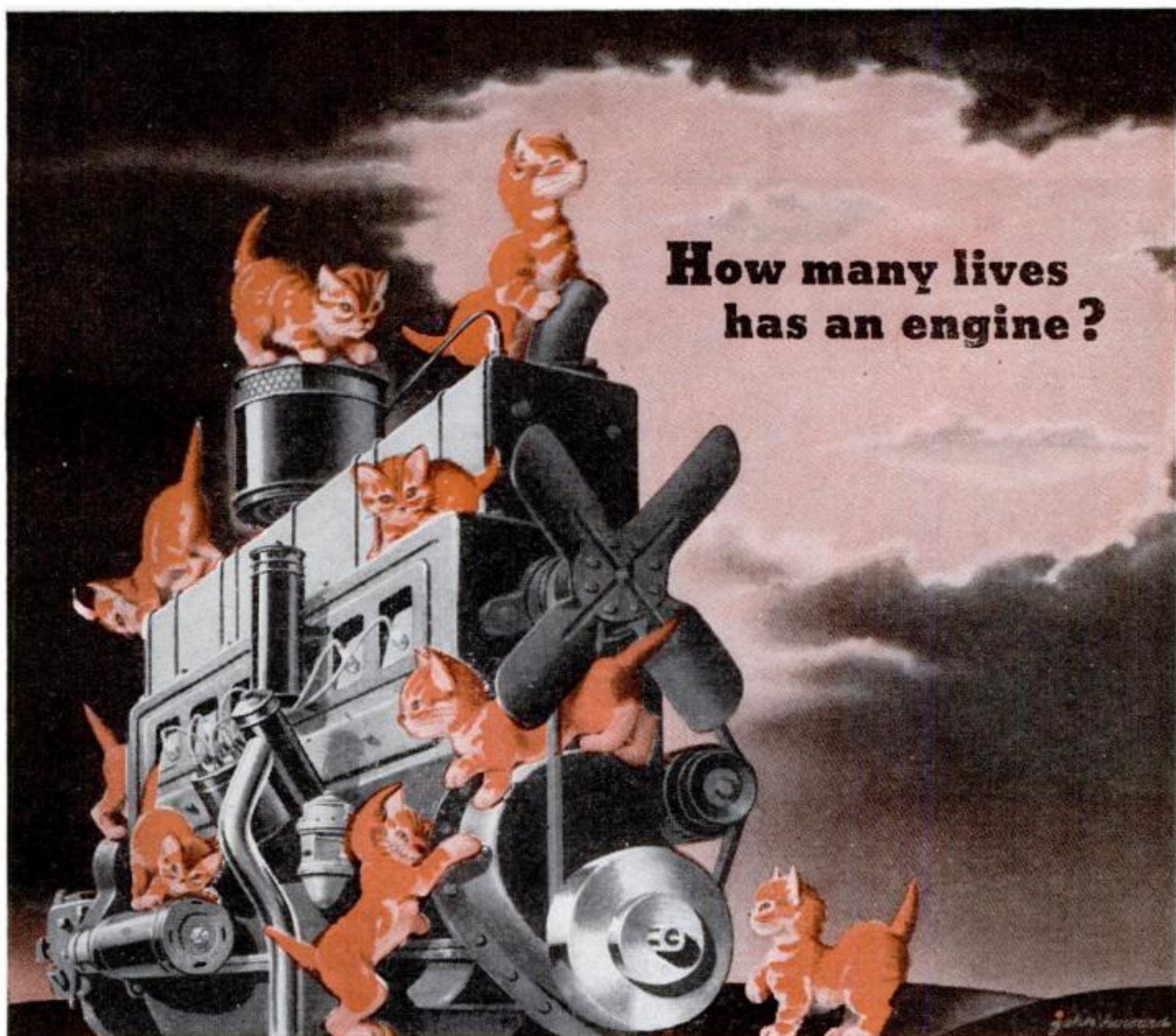
But the proprietor had effectively hidden his airport. In disgust we crossed the city and hunted for another one. We found it.

Now that meteorological "low" got down to business. The next day the wind blew at 35 miles an hour on the ground; at 50 miles at an altitude of only 2,000 feet, the height at which we were flying. We didn't want to risk our plane in wind like that. We stayed aground. We didn't mind. We had come 657 miles in a day and a half, taking our time.

A flying vacation is a lazy one. We rolled out of bed when we chose and flew only as long as we felt like it. Yet we averaged more than 450 miles a day for the trip. That, of course, counts the time we were in the air and not the delays due to weather.

The next day was our biggest. Without trying hard, we covered 628 miles. We were off the ground shortly before 9 a. m. At St.

(Continued on page 210)



**How many lives
has an engine?**

● The cat-of-nine-lives has nothing on the automobile engine. Its one life can be stretched, and stretched—long beyond our pre-war beliefs. All it takes is attention . . . and the prompt replacement of worn parts.

Among the parts you must watch are the piston rings. They take a beating in any engine, and they last a long time. But when they do wear out they

must be replaced promptly to protect the cylinder walls and other vital parts.

At the very first sign of ring wear—smoke, oil-pumping or loss of power—it will pay you to get Hastings piston rings. They stop oil-pumping, check cylinder wear and restore performance. Ask any motor specialist.

HASTINGS MANUFACTURING COMPANY • HASTINGS, MICHIGAN
Hastings Mfg. of Canada Ltd. Toronto



HASTINGS STEEL-VENT PISTON RINGS

Tough on Oil-Pumping. Gentle on cylinder walls.

TOUGH BUT OH SO GENTLE



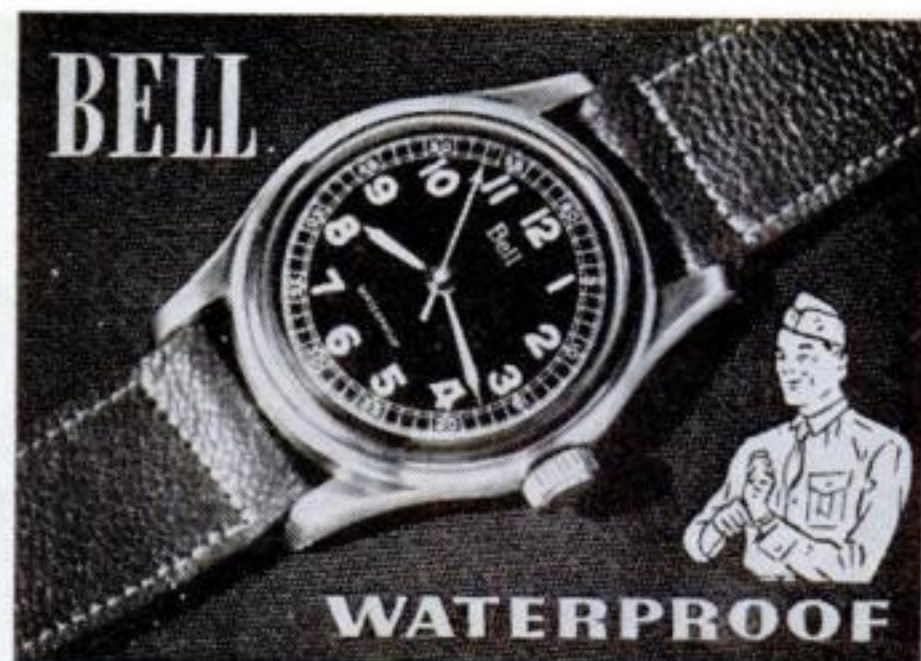
For the Critical Jobs Snap-on Tools



Sweeping the stratosphere at better than 400 mile speed — screaming earthward in bomb dives — blasting tanks, locomotives, fuel dumps in low level strafing . . . Republic's deadly Thunderbolt handles diverse tactical assignments superbly well. The Thunderbolt is super-powered, heavily armed and armored . . . and its mighty engine is anchored with just four one-inch bolts. In this photograph a Republic worker tightens to solid security one of the four vital nuts . . . and does it easily, safely, swiftly . . . with the *right tool* for the job . . . a Snap-on heavy duty ratchet wrench.

Everywhere in industry Snap-on tools play an important part . . . dependable aids to fast, accurate workmanship in every phase of production, assembly, maintenance. Snap-on direct-to-user tool service is available through 38 branch warehouses located in key production centers. Write for 1945 catalog.

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Waterproof, shockproof, anti-magnetic, radium dial and hands, unbreakable crystal, precision tested, sweep second hand.

No. BF 121 15 jewels, stainless steel back.....	\$39.75
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REFINISHING HINTS

Shinola Wax Shoe Polishes in HARD-TO-GET COLORS



• If you've got a nick or mar to cover in a table top . . . or want to bring back the rich, mellow finish on an old piece of cherry, maple, or pine furniture . . . or finish a repaired section to match older wood . . . here's an assortment of colored waxes all ready to use.

Shinola Wax Shoe Polish in Tan (Russet), Brown, Ox-blood, and Black, applied and finished like any other wax, is also grand for models, leather and linoleum. And remember—Shinola helps keep shoes new-looking longer.

SHINOLA—10¢
IN ALL COLORS

TAN (RUSSET) • BROWN
OX-BLOOD • BLACK



(In Canada it's 2 in 1)



Quiet

BALLENTINE



MOTORS

Design engineers looking for peak efficiency and long life in fractional H.P. motors, will pick a QUIET motor—A BALLENTINE MOTOR. Because only skilled craftsmanship, strict adherence to close tolerances, *precision dynamic balance* plus modern manufacturing methods and equipment can produce a truly QUIET motor. In BALLENTINE MOTORS, the engineer finds all these factors—*at their best*—combined with suitable mechanical and electrical design. Quiet BALLENTINE MOTORS are available in ratings from 1/1000 to 1/6 H.P.—adapted to your specific application.

Write for descriptive bulletin.

RUSSELL ELECTRIC COMPANY

358 W. HURON STREET, CHICAGO 10. ILL.

Manufacturers of **BALLENTINE MOTORS**

AUGUST, 1945

Buy War Savings Bonds and Stamps regularly.

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LONGER LIFE
GREATER POWER
SMALLER SIZE

P.R. MALLORY & CO., Inc.
MALLORY
Tropical*
DRY
BATTERIES

New—fundamentally different — originally developed by Mallory for the U. S. Army Signal Corps.

Now all output goes to military use, but when peace arrives civilians will have new standards of dry battery performance.

P. R. MALLORY & CO., Inc.
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*TRADE MARK

P.R. MALLORY & CO., Inc.
MALLORY

A Flying Vacation

(Continued from page 206)

Louis we broke our rule about avoiding terminal airports, and paid for it by being forced to taxi a half mile to the gas pit. At Jefferson City and Clinton, Mo., we put on the airport hunt that we had come to accept as inevitable and settled for the municipal airport at Wichita rather than make a third hunt for the day with the sun half below the horizon.

At Goodland, Kan., near the Colorado border, the Government meteorologist took us in hand.

"There are some thunderstorms moving in, coming northeast from Pueblo," he said. "If you meet any of that stuff, come on back."

The storms came. Clouds, an enticing white on their towering tops, a purple-black laced with lightning in their interiors, stood athwart our flight path. I was flying.

"I think we ought to leave our course or go back," remarked Groenhoff.

"I don't want to go back," I said. "Let's leave our course."

In country like that, where the plains go on forever, wandering around complicates aircraft navigation. But we had to dodge the storms. Groenhoff spelled me at the controls and I took charge of the maps.

"I'm not following you," I had to confess presently. "We're somewhere in here"—pointing at the map—"but I don't know where." Below us the terrain looked the same at all four points of the compass, a checkerboard in green.

Groenhoff squinted out his window. "This is a heck of a place to get lost," he agreed.

In the September issue, Devon Francis will tell how Groenhoff and he, forced off course by bad weather, began relying on radio navigation to complete the round trip to Colorado.

DON'T WASTE WASTE PAPER

BUNDLE up your old newspapers, magazines, out-of-date correspondence, wrapping paper, and the contents of your waste baskets. Then either sell it to the junk man or turn it over to the local salvage committee for reprocessing into vitally needed containers and cartons for food and other munitions of war.



He's a new kind of independent business man. His head's in the clouds, but his feet are on the ground. He sells Aeronca personal planes and service, with equal emphasis on both—proud to represent Aeronca in his territory.

Aeronca can't help knowing a thing or two about personal flying. They produced the first light plane ever made. That was

17 years ago, and they've been making 'em ever since. They know good flying depends on good service—and that you can't enjoy good flying without a network of airports and landing strips everywhere. So they've been pioneering *that* idea, too!

This company's complete dealer program makes air-minded people look for the name "Aeronca" everywhere. It means the last

word in service, the last word in personal plane engineering—easy to buy, easy to fly! A booklet—"Aeronca—the Plane You'll Want to Fly"—tells more of the story. Send 10¢ for your copy, to Aeronca Aircraft Corporation, Dept. PS-8, Middletown, Ohio.

(Export Agency—AviQUIPO Inc., 25 Beaver St., New York 4, N.Y.)

AMERICA'S PERSONAL PLANE
AERONCA
 has an important message for air-minded people





Quick, Mabel! Reach in my pocket for the Weldwood Glue.



WHEN you want to fix things fast...remember Weldwood Glue. It's quick to mix...easy to use...tremendously strong...stain-free...rot-proof...and permanent. At hardware stores, lumber yards, chain stores.

WELDWOOD PLASTIC RESIN
WATERPROOF GLUE

Buy War Savings Bonds and Stamps regularly.

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FIRST PRIZE—\$250.00 TO

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Spring Clasp, adjustable snap-on Beverage Bottle Cap.

SECOND PRIZE—\$125.00 TO

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Pocket or Desk Pencil Sharpener with chip receiver.

THIRD PRIZE—\$50.00 TO

**ANTHONY J. MONTE, AMMI 2/c, U. S. N.
NAVAL AIR STATION, GROSSE ISLE, MICHIGAN**

Cigarette Holder with automatic ejection dispenser.

And to all of you who entered the Contest we want to express our gratification and our appreciation of your independent, creative thought. We would like to declare every contestant a winner; the least we can do is assure you that this company will strive to place before you only worthwhile goods, that the (km) trademark will appear only on quality merchandise carefully manufactured of the best materials.

Thank you.

**THE F. J. KIRK MOLDING COMPANY
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Roll, enough for 7 feet of 1/2" pipe



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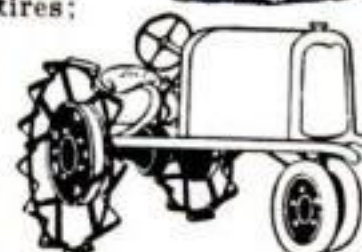
BUILD YOUR OWN RIDING TRACTOR—"WAR HORSE"

using old auto parts, powered by 2 H.P. or larger air-cooled engine; or walking type Garden Tractor 1/2 to 3 H.P. or convert truck or auto into Farm Tractor. Each with steel or rubber tires; will plow, cultivate. Plans for building, in few hours, any one of above, postpaid for \$1.00 (state which wanted) or all 3 for \$2.00. Money Back Guarantee!

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To mend a working plan or
A blueprint torn in two,
Transparent Texcel's just the thing-
It fixes things like new.

(Texcel mends securely—the "stickum's" bonded on!)

To seal a picnic box up tight
And guard the contents' flavor,
Use Texcel Tape—it's strong, it's neat,
It's quite a paper saver.

(Texcel holds and holds—the "stickum's" bonded on!)

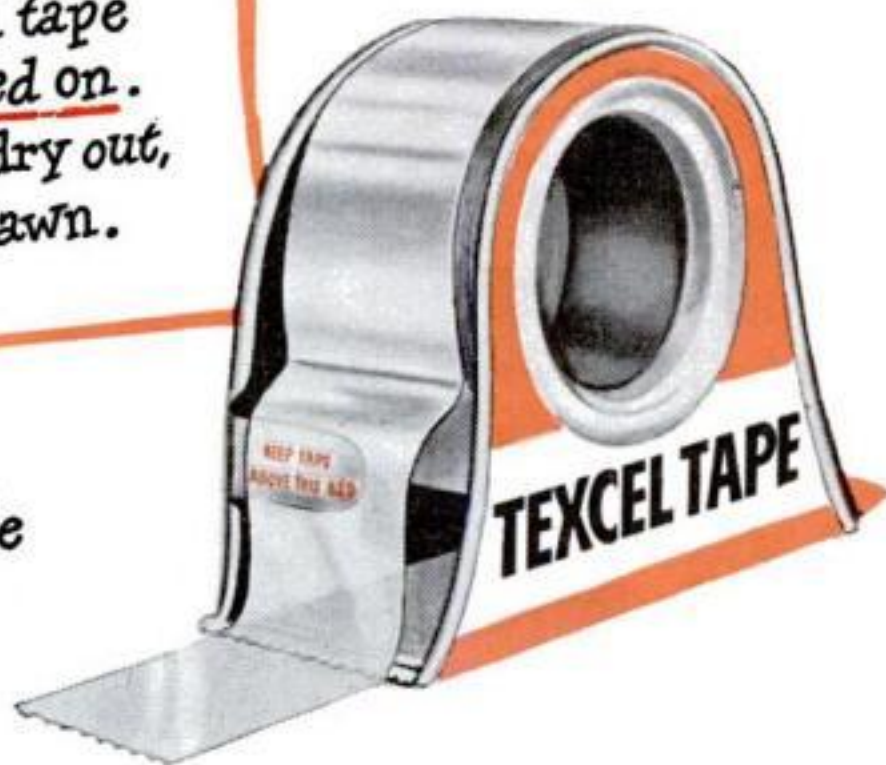


For wrapping packages and gifts,
And making them look dandy-
For these and countless other jobs,
Some Texcel's mighty handy.

(Texcel means no gummy edges—the "stickum's" bonded on!)



Yes, Texcel is an improved tape
Whose "stickum's" bonded on.
It won't come off, it won't dry out,
It holds with lots of brawn.



Today most Texcel Tape that's made
Is being used for war,
Buy Bonds and Stamps till Victory
Returns it to your store.

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New Brunswick, N.J.

Texcel Tape

REG. U. S. PAT. OFF.

CELLOPHANE TAPE — STICKS WITH A TOUCH

AUGUST, 1945

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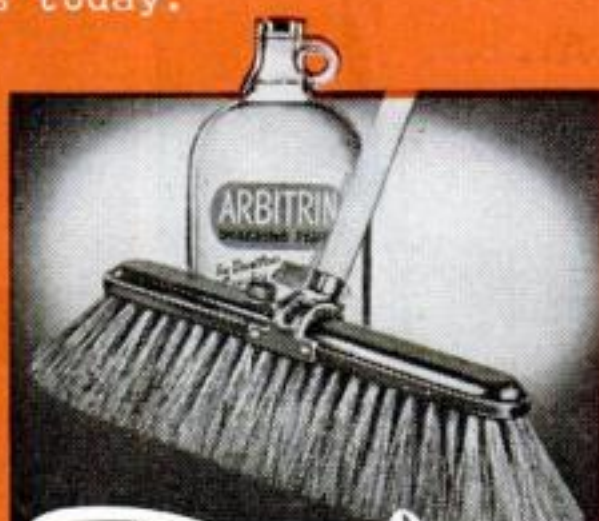
213

NO MORE SWEEPING COMPOUND



Sweeping the modern "Dustless" way forever eliminates sweeping compound.

Here's why: As you sweep with a Dustless brush, Arbitrin sweeping fluid, fed from a reservoir in the back of the brush, moistens the dust. Instead of rising into the air, the dust itself is converted into a sweeping compound that sweeps many times cleaner and safer than any commercially prepared sweeping compound at any price. Thousands of factories, shops, offices, and schools have adopted this "Dustless" method of sweeping. You ought to know more about it. Write for complete facts today.



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Dustless
DOES MORE FOR LESS

MILWAUKEE DUSTLESS
BRUSH COMPANY

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What Makes Rockets Go?

(Continued from page 71)

stant thrust is preferable. So the grain has been made solid, but shaped so that the burning surface grows smaller less rapidly than the fuel is consumed. A cross section of one of these arrows resembles a cross, or plus mark, because this shape contributes to the steadiness of the jet and thus increases a rocket battalion's chances of demolishing a small, distant target.

The sensitivity of the chemical compound in these arrows is so great that the rocket's performance may even be affected materially by the weather. On a warm day, the fuel begins to burn so much more quickly than on a cold day that the acceleration of the rocket is appreciably greater.

A tiny air hole or defect in the texture of the arrow may cause it to explode rather than burn steadily. In that case, our own men may be killed. And even a minute irregularity in the surface of the arrow may cause the rocket to swing and sway in its flight and fall to earth far from the target.

Each of these arrows, therefore, is a precision job. About 40 different inspections are made during the manufacturing process. Every arrow is X-rayed to determine the homogeneity of the material. The whole surface of each arrow sent to the front is within one thousandth of an inch of the specified dimensions. And every tenth arrow completed is test-fired.

The ordnance plants where these arrows are made cover many square miles, because each important step in the manufacturing must take place in a separate building. Many of these buildings are air-conditioned and heavily barricaded. Nozzles of the world's fastest automatic-sprinkler system surround the machinery where the tricky ingredients are mixed, and the workers wear flameproof uniforms, and safety shoes, gloves, and masks.

The nitrocellulose used in these arrows could be made anywhere and shipped to the rocket-powder plant. But it is made right there, so that the manufacturers can control the whole process rigidly. Nitroglycerin is so unstable that shipping it far would be dangerous. So it, too, is produced in the rocket works and cautiously moved to the point where it is mixed with the nitrocellulose in rubber-tired handcarts.

When mixed, this witches' brew is a paste, which is rolled out in a long, black carpet. Like wild-animal trainers, the girls who handle the paste never turn their backs or take their eyes off the tricky stuff. And

(Continued on page 218)

"LOTS OF ROOM . . .
C'MON ALONG"



There's a *Ford* in your future!

WHEN America's biggest job is done, a smart new Ford will point the way to pleasures now denied you. And you will want to share them. . . . Here will be a handsome car. Big and roomy. Behind the wheel you'll find new driving pleasure. It will be so nimble—so responsive. Difficult parking problems will yield to its easy handling.

. . . Naturally, this new Ford car will be thrifty and reliable. . . . Everywhere you look there'll be improvements—more of them than have been offered in many pre-war yearly models. All the skill and experience which Ford has gained in more than 40 years assure you this.

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AUGUST, 1945

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215

Preserving Power



for the Three Great Powers

(THE UNITED STATES—RUSSIA—BRITISH EMPIRE)

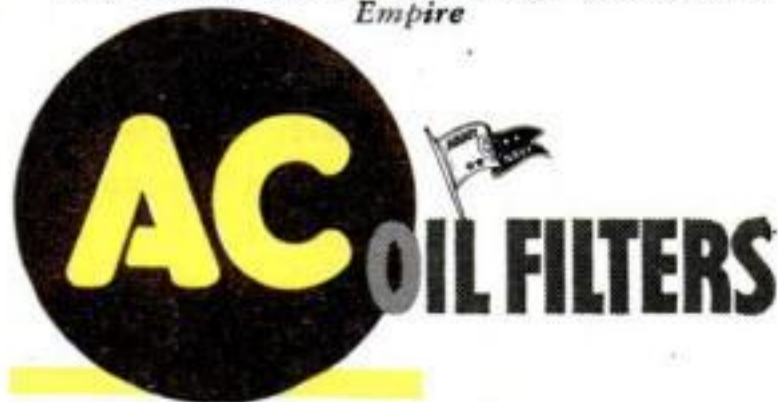
To win battles, it is necessary to defeat the enemies of our mobile equipment. Dirty engine oil is one of these. It clogs oil passages—makes valves stick—robs engines of power—hastens engine wear.

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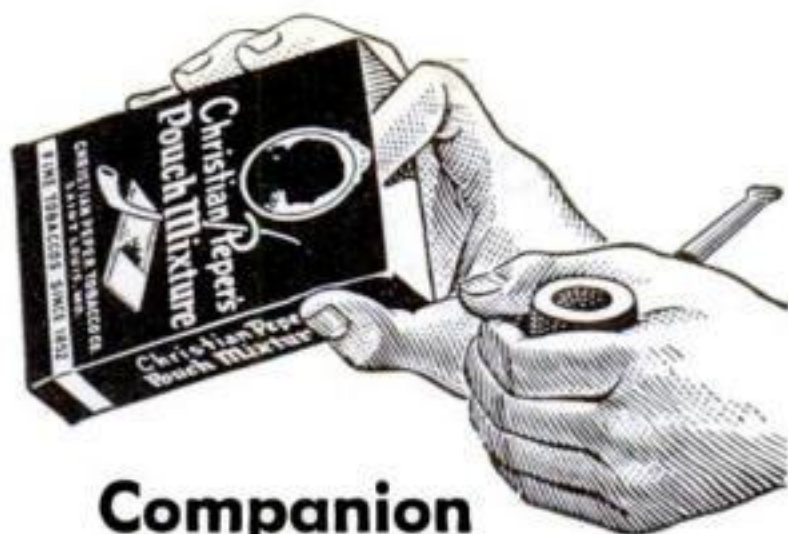
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What Makes Rockets Go?

(Continued from page 214)

the operators step out side the building while the machines do the most dangerous part of the work.

The big carpet is cut into strips and rolled into bundles. These resemble jelly rolls, but have the sickeningly sweet odor of dynamite. They are dried and placed in a hydraulic press, which squeezes them under a pressure of 5,000 pounds per square inch into long, cruciform rods.

This press is operated from a control panel outside a barricaded building, but the operator re-enters the building after a rod has been extruded and slices it into arrows of the required length with a guillotine knife. Others then inspect and mill each arrow, and shove it into a lead box to be scrutinized by X rays.

The arrows chosen for test-firing are removed to loading rooms, where the temperature and humidity are so controlled as to simulate the atmospheric conditions in which the rockets will be used. Each arrow is bolted to a concrete block, to prevent it from hurling itself through the air, but its power is ascertained by gauges and photographs.

Inside each gauge there are a tiny hammer, anvil, and copper ball. The jet from the test arrow hurls the hammer against the ball. Operators then remove the ball from the gauge and measure the amount that it has been compressed.

The jet is also photographed indirectly with a rotating-drum camera that records the deflection of light from mirrors attached to galvanometers. The picture obtained is actually a bell-shaped chart that shows how many hundredths of a second the fuel burned, how quickly the gas pressure rose, how steady this pressure was, and how it tapered off.

But what use will the world have for such self-driven arrows in peacetime? Hercules Powder Company spokesmen see no reason why such a propellant cannot be used to whisk heavily loaded airplanes off the ground. Twenty percent greater cargoes could be carried with such take-offs.

With the ending of the war in Europe, the details of many hitherto secret military developments can now be revealed. To bring our readers as much as possible of this timely material, we have postponed publication of the article on using surplus war goods, previously announced for this issue.



YOUR dreams of a new home must wait on the future. But if you could see all the thrilling advantages that are being planned by American industry for your post-war home, you'd agree that it's well worth waiting for!

● ● And now that V-E Day belongs to history and part of the battle has been won, you'll feel all the more like buying additional War Bonds, both to speed final Victory and to help finance your new home when you're ready to build it.

● ● The modern techniques of functional

design and compact construction which enabled Defoe to build seven different types of fighting ships for the Navy will be converted to producing quality-built homes in the postwar period.

● ● Defoe will produce homes with advantages of beauty, comfort and livability heretofore unknown in their price range. There will be nothing stereotyped, extreme or fantastic in Defoe homes. They will combine functional convenience with a wide range of individual designs, yet give you all the economies of volume production.

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HOUSING DIVISION-DEFOE SHIPBUILDING CO.,

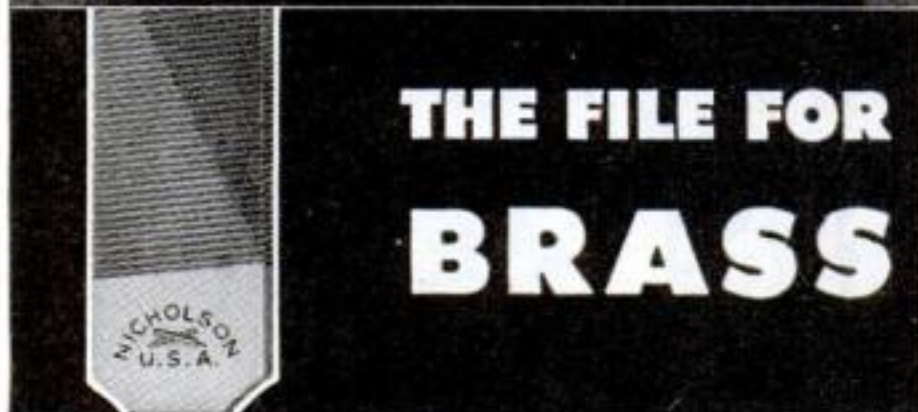
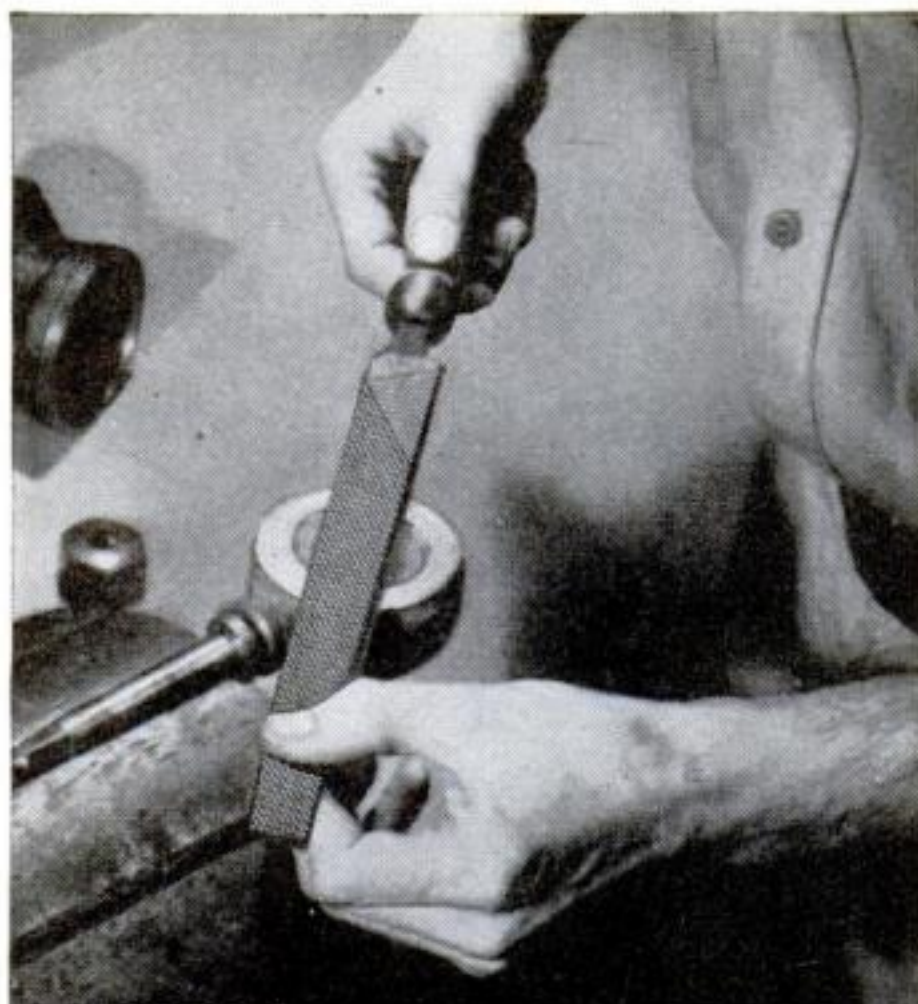
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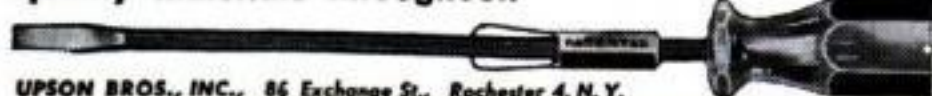
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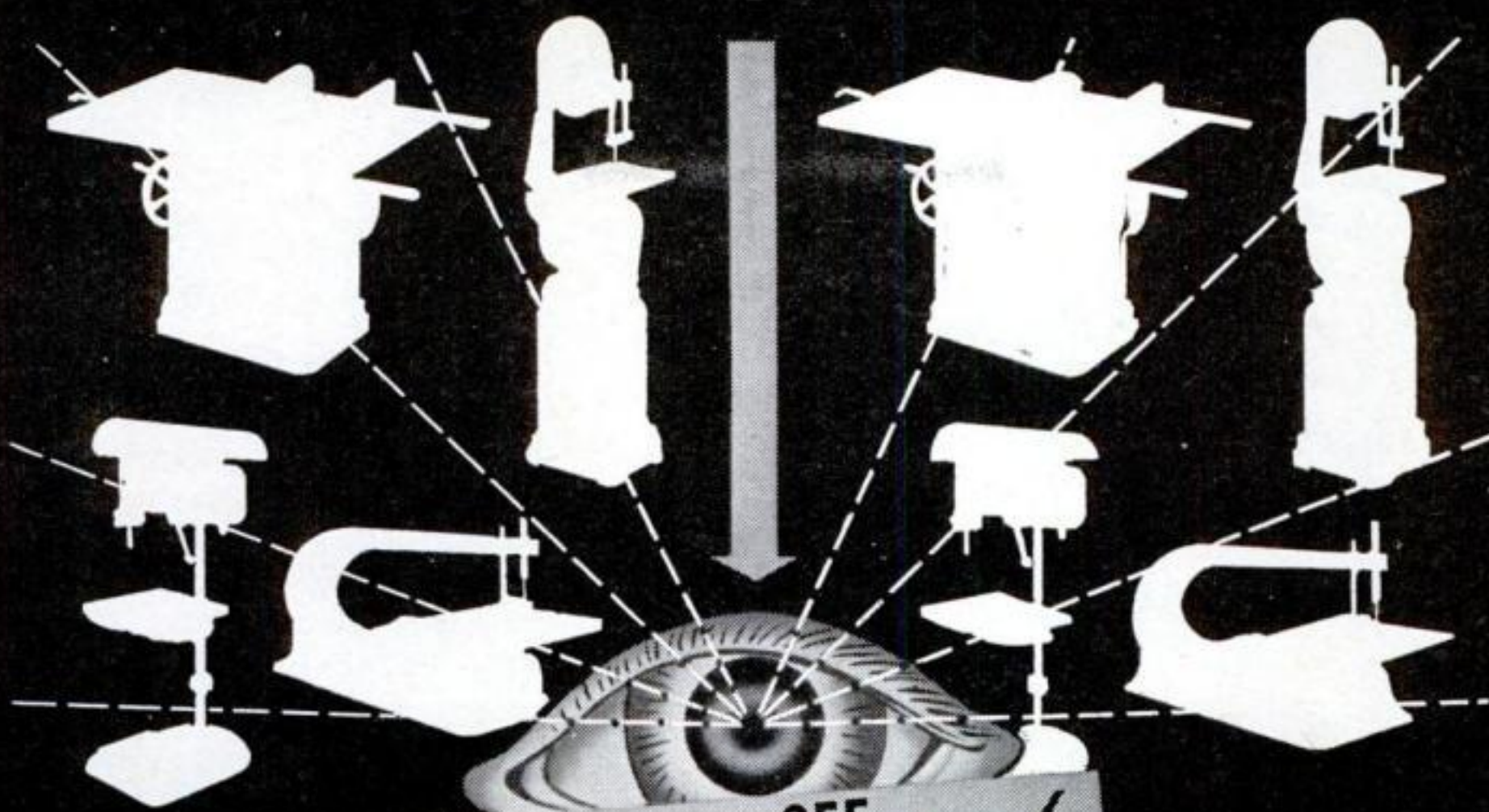
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difference between
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4 *Precision-ground Shafts.* These are shafts built to run without any "wobbling" which might throw off your measurements.

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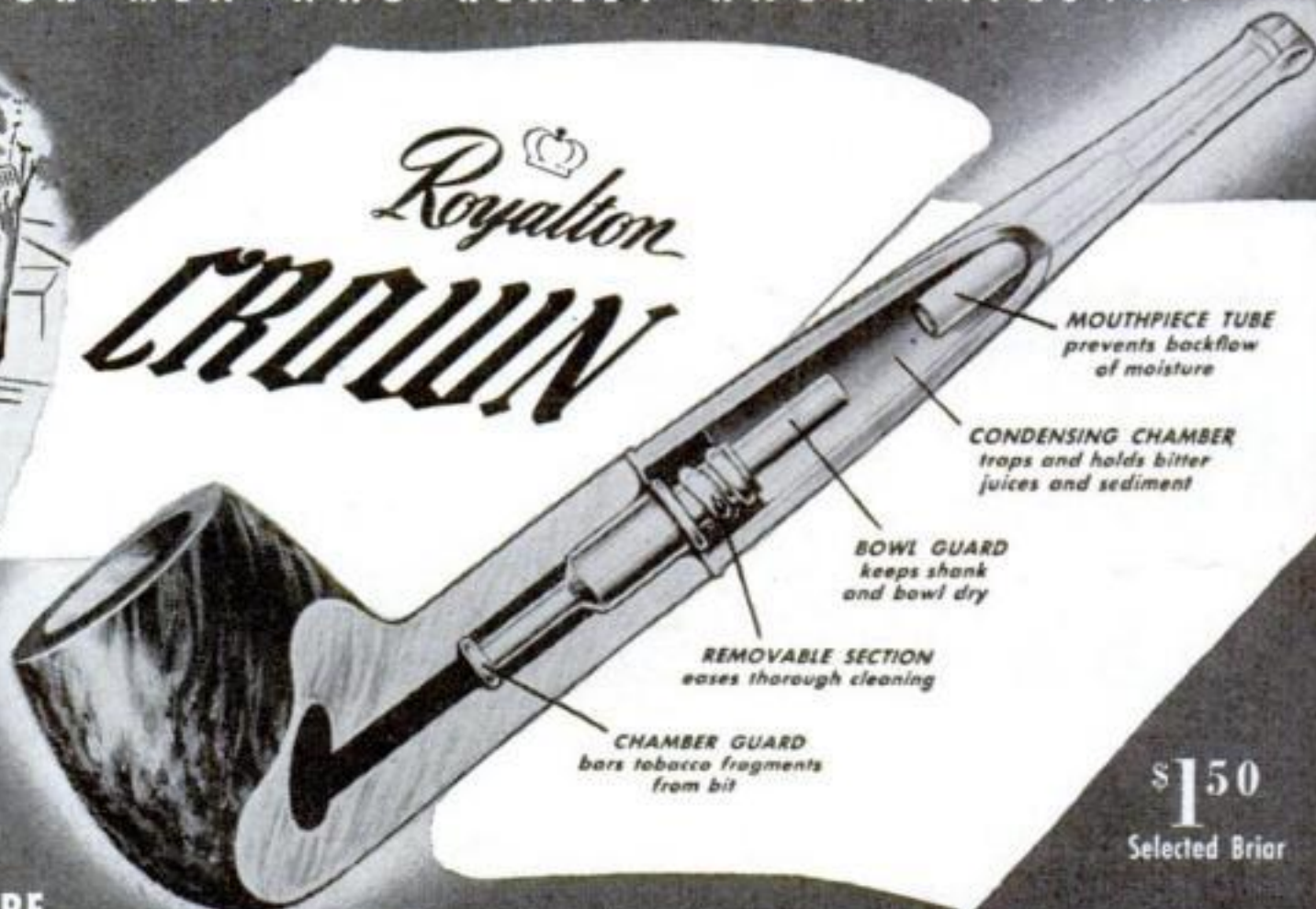
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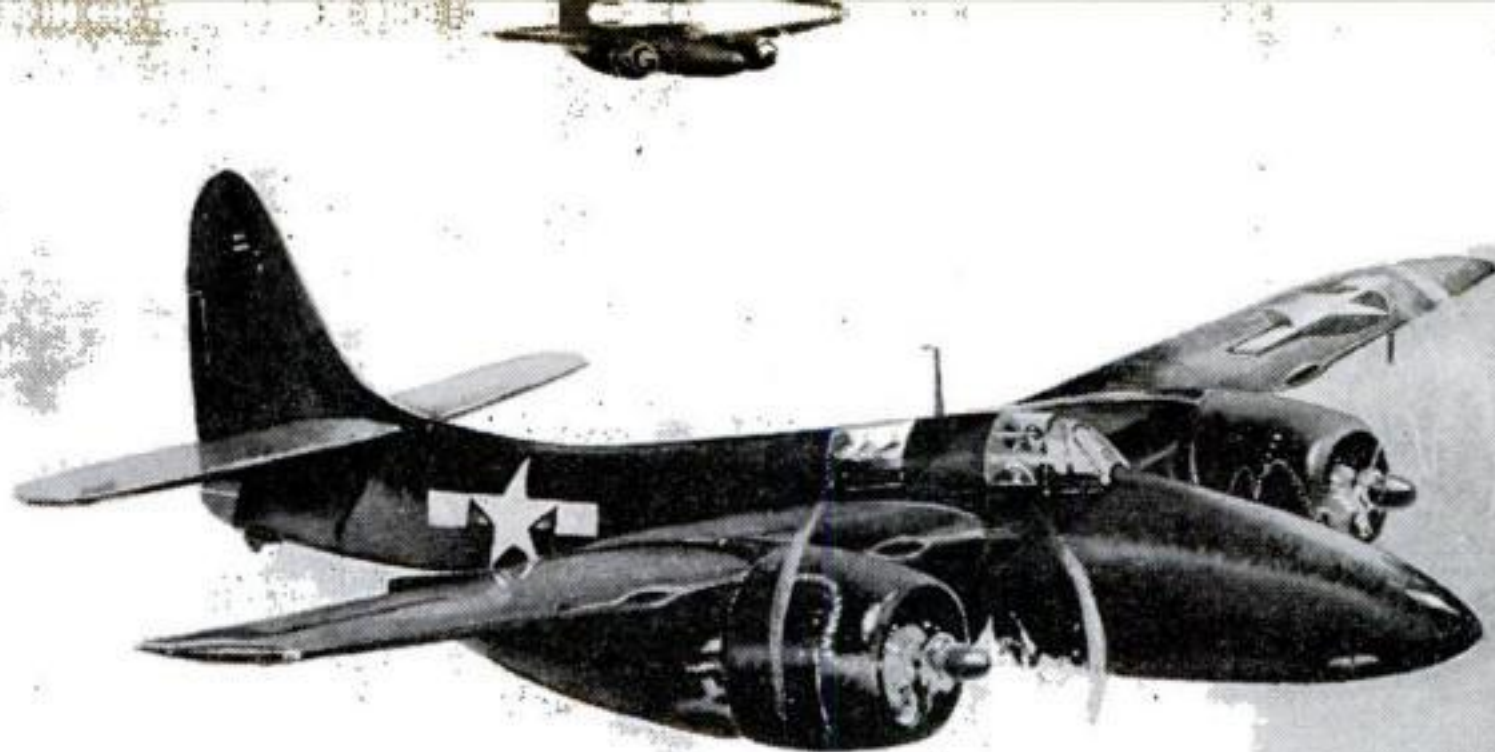
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POPULAR SCIENCE



(Example 4) 1945

U. S. Navy's Latest Jolt for Japs — The Grumman Tigercat

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Pickaback Barges

(Continued from page 76)

mented boxes, from 200 to 250 feet long, and wide enough to hold two trains of six cars each. If you're a good observer, you probably know that a tugboat moving a string of boxcars across the quiet waters of a harbor is usually hooked to the side of the rectangular float. No towboat could shove a heavily loaded railroad ferry through an Atlantic storm that way. Hence, extensive alterations had to be made to permit the tugs to pull these barges the way a horse pulls a wagon.

LT's (large tugs) of 600 tons, with 1,500 horsepower, did the pulling. Running light, one of these boats could do 14 knots, but it could only crawl with two of the pickabacks, each weighing several hundred tons, in tow behind it. Even under ideal conditions, the best speed possible was only six knots—about 144 nautical miles a day.

ST's (small tugs) brought up the rear of the convoy. They were only half as big as the LT's and much less powerful, but they would be needed at the beachheads and in Europe's harbors, and could be used while crossing the Atlantic to curb the drifting of barges that broke loose.

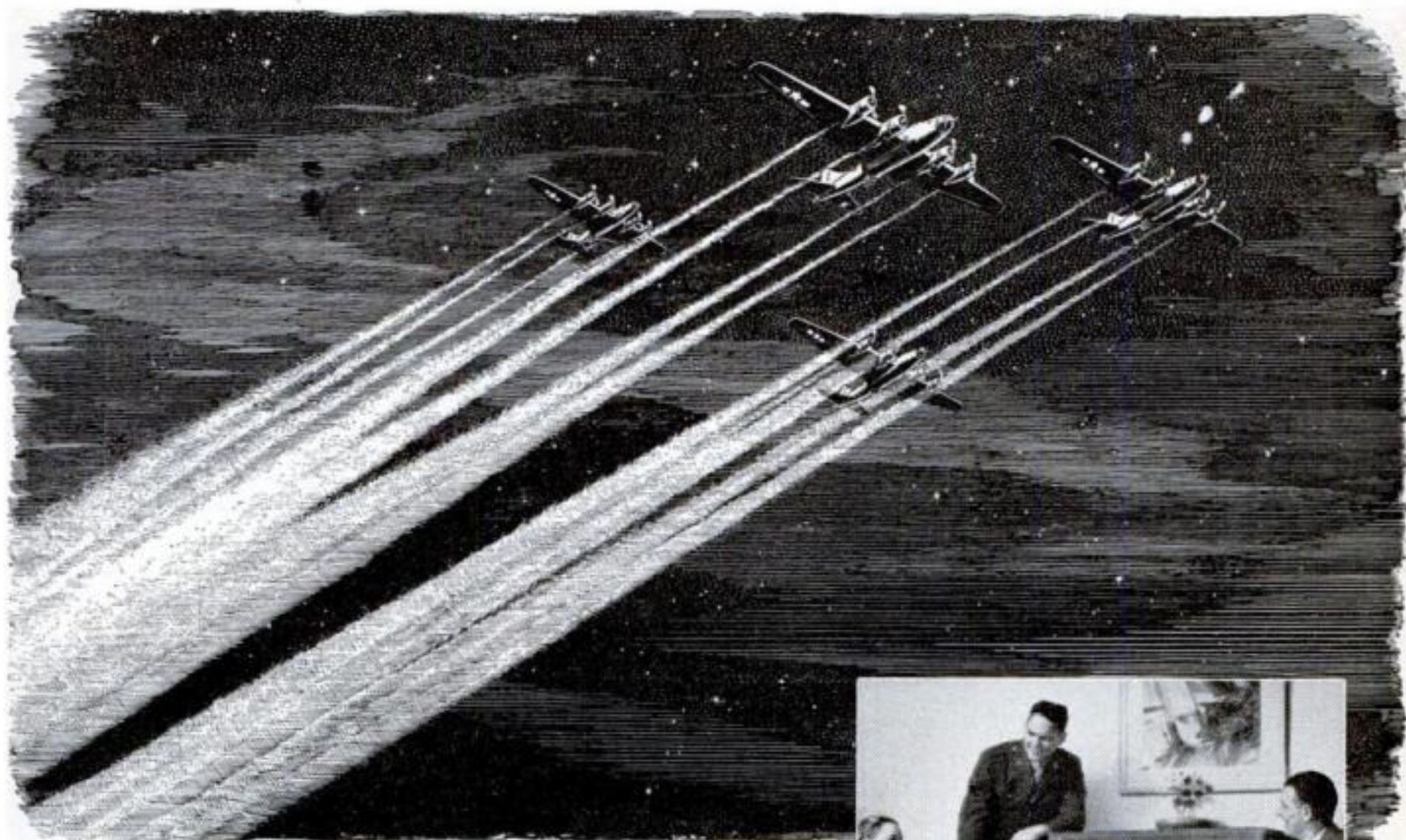
If you rode a bucking bronco for a month, without dismounting to eat or sleep, you'd have a rough idea of what the towboat crews endured. The pendulum that recorded the rolling in the engine room of one LT hit the 50-degree mark. Men not only became seasick, but were black and blue from being hurled against walls and decks. Some learned to sleep with their bodies rigid and their arms and legs braced against the sides of their bunks. And they entered and left their cabins via the portholes rather than the doors because of the waves rolling over the decks.

Repair crews often had to board the pickabacks to pump leaking floats out with handy-billies and to reattach the heavy iron chains and the 12-inch hawsers when bridles snapped. Two men died and a third was seriously injured when their rubber boat was crushed between a tug and an escort craft. Many others who were swept into the sea in gales that reached 97 miles an hour were saved.

But the battle of the barges was won. The Army mastered the unprecedented trick of toting barges across the ocean on other barges. And some of those same old ferries from American harbors that went to Europe may be doubled up again now for another long tow—through the Mediterranean, the Suez Canal, and the Indian Ocean for another invasion.—VOLTA TORREY.

ON ITS WAY!

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**With Exciting New Radionic* Marvels
War-Proved in the Stratosphere . . .**

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FROM WAR-TORN SKIES of numbing cold and violent shock—where life and victory often depend on radio communication—have come great new advances in the science of RADIONICS.

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Zenith does not spread itself thin over unrelated fields like refrigerators, ranges, washers, irons. Every Zenith worker is a *specialist* in RADIONICS—the science of transmitting and receiving radio waves. No wonder your new Zenith radio will offer value far beyond anything you’ve ever known before.

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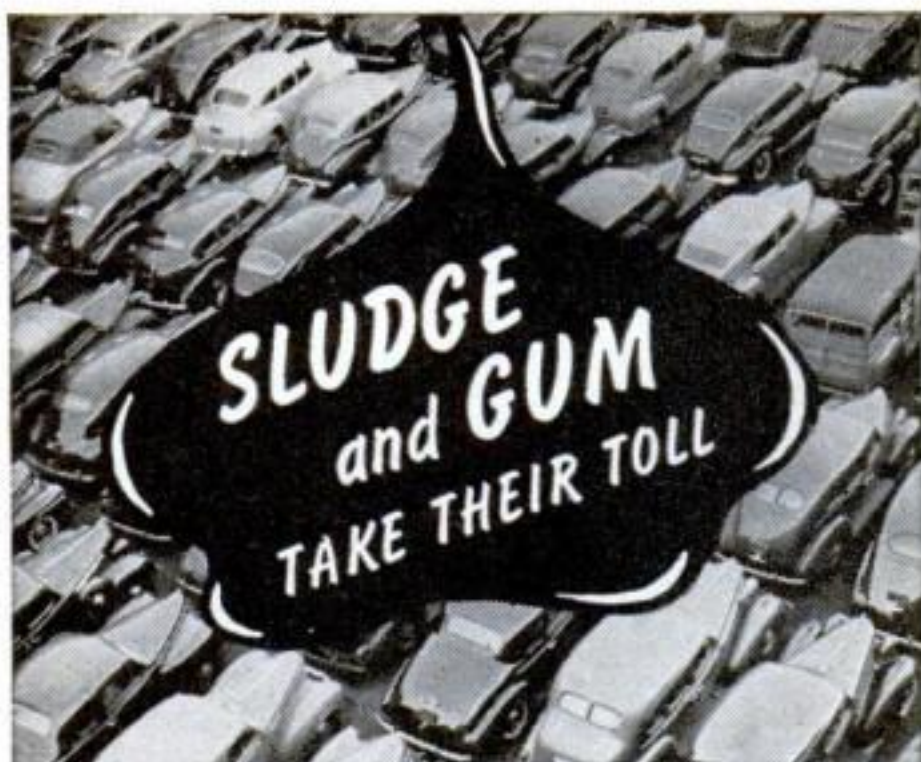
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AUGUST, 1945

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TO CLEAN OUT
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TO KEEP IT
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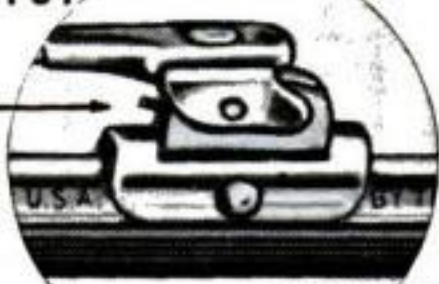
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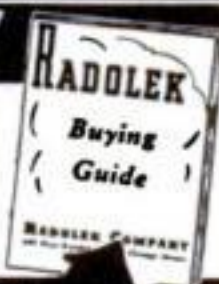
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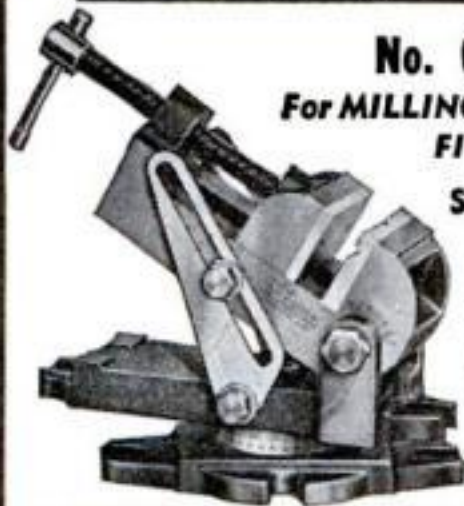
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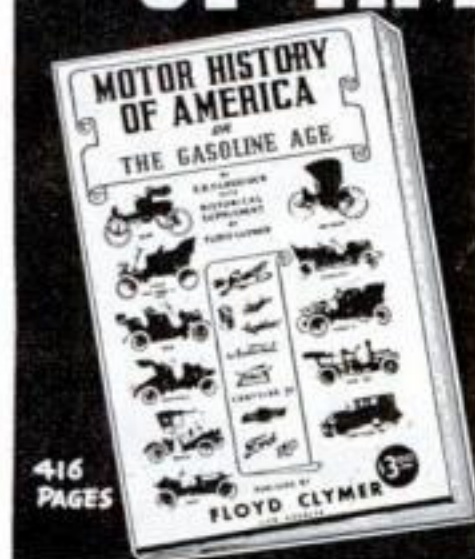
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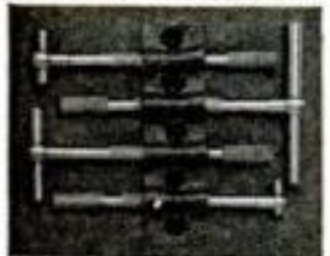
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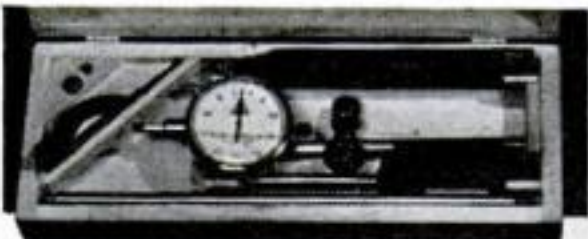


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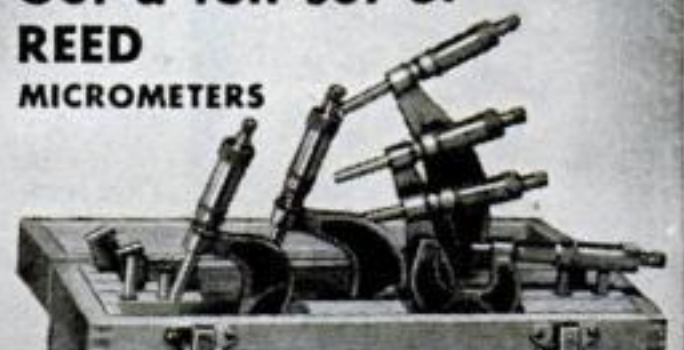
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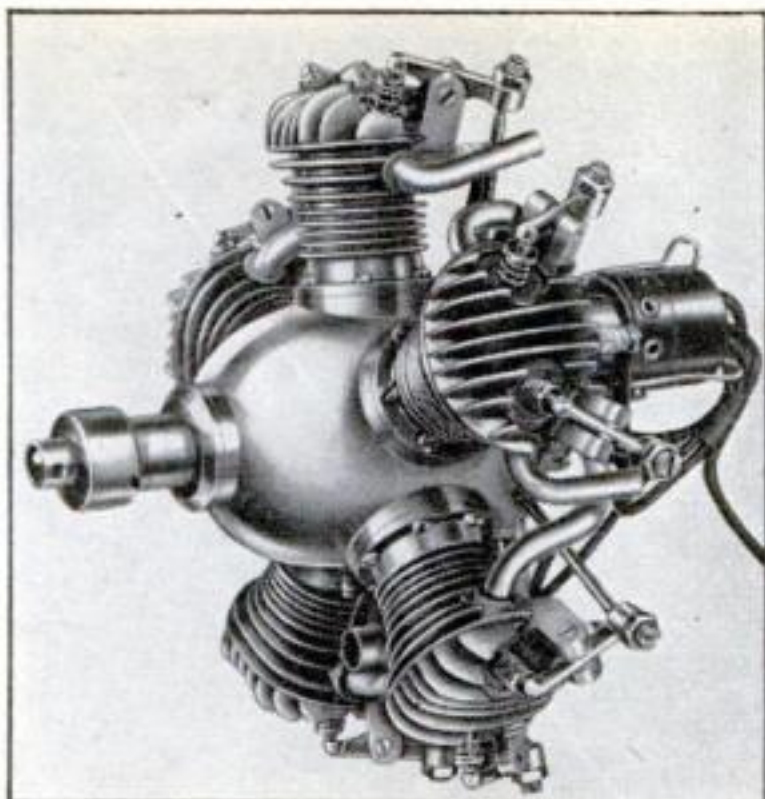
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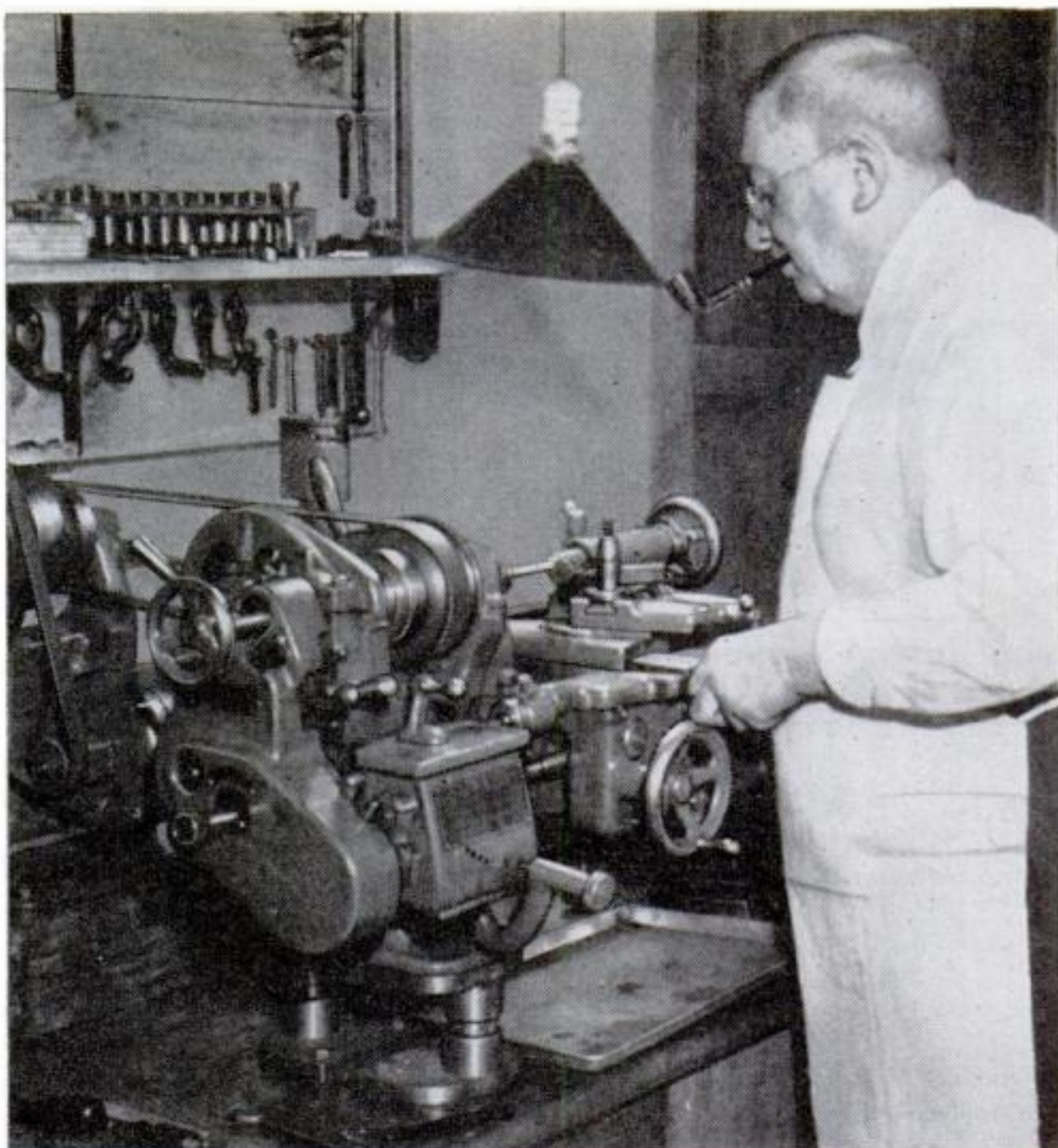
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